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REPORT ON THE SANITARY STATE & SANITARY REQUIREMENTS OF BOMBAY.

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BOMBAY BRANCH
OF THE
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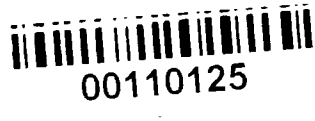
TOWN HALL, BOMBAY.



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REPORT ON THE SANITARY STATE AND SANITARY REQUIREMENTS OF BOMBAY.

No. 74 of 1852.

To GEORGE HANCOCK, Esq.,

Clerk to the Board of Conservancy.

Sir,

I have the honour to acknowledge the receipt of your letter No. 37 of 1852, stating that you are directed by the Committee appointed by the Worshipful Bench to consider and report upon the income and expenditure of the Municipal Fund, to request me to submit, as soon as possible, to the Board of Conservancy, a statement whether any and what public improvements are urgently and immediately required for the improvement of the island, accompanied by a rough estimate of the probable expenditure involved; and that *I should submit, at the same time, the grounds on which I consider such improvements to be of urgent importance.*

2. To prepare an answer in detail, and at a length commensurate to the importance of the subject, to a question so voluminous as the foregoing, would require more time than I believe the Committee could afford to wait. I am given to understand, however, that their object in calling for the statement in question is merely to ascertain whether the municipal revenue bears such a proportion to the urgent and immediate sanitary demands upon it as would justify the Committee in recommending the alienation to other purposes of funds hitherto appropriated to a class of improvements, the immediate result of which (as I shall presently prove) is to reduce by 20 per cent. the *average* death-rate of the streets in which they are effected; and the information requisite for answering the question to this extent can be afforded without delay.

3. The Committee have requested, that in forwarding a list, ac-

companied by a rough estimate of the probable expense of the public improvements urgently and immediately required, I would submit at the same time the grounds on which I consider such improvements to be of urgent importance. I am sure that the Board of Conservancy will be of opinion that all improvements, the postponement of which can be proved to be attended by an annual and considerable loss of human life, *must* be considered as "immediately and urgently required." I shall therefore endeavour to show, in the *first* instance, that there are sufficient grounds for arriving at the conclusion that one-half (or about 8,000) of the deaths that annually occur in Bombay are due to various removeable causes, and that the drainage of undrained streets would, according to the highest English authorities, of itself, and irrespective of all other sanitary improvements, reduce our annual death-rate by at least 20 per cent. or about 3,000 souls a year; and then proceed to consider the accompanying list and rough estimate of the more prominent of the improvements requisite for obtaining so desirable a result.

4. The present sanitary movement in England is even there of very recent origin, and the great importance of the subject has been as yet scarcely recognised in India. The elaborate data for sanitary reform afforded in England by the lucid and voluminous reports of the Registrar General, of the Parliamentary Commissions for inquiring into the health of towns, and the similar reports of municipal corporations and private associations, are altogether wanting here; we are, indeed, without the first basis for sanitary statistics—a trustworthy census, and annual mortality return; our town, with half a million of inhabitants, is not divided (as for half a dozen municipal and sanitary purposes it ought to be) into any *generally recognized* districts and sub-divisions; the houses have one number for police and census, and another number for house assessment. There is, in fact, a general want of unity and system. The assessed value of houses in each particular street, as compared with its population and mortality, always forms a most important and instructive element in sanitary statistics, but the house assessment returns at Bombay are now so taken as to be altogether inapplicable to such a purpose, and no complete or systematic surveys or levels have ever been taken of the town. The Native Town is, moreover, as regards its position, most unfortunately situated for being known to, or for interesting the educated and more influential classes (whether Native or European) of our community. The principal acquaintance of these classes with the Native Town is generally formed by traversing the Kalkadavee or Girgaum bazar roads, in going from the country into the Fort, or from the Fort into the country; and of all the densely-peopled districts lying *behind* these great thoroughfares they generally know as little as they do of the interior of Africa.

5. In the absence of equally complete local data, I must have recourse *principally* to English sanitary statistics, to show what would be the effect of sanitary improvements in diminishing the annual death-rate of Bombay; but I think that such English data will be allowed to be perfectly applicable to the case; for if it be shown that the existence of open drains and cesspools, &c. in a crowded English town invariably occasions a certain, specific, and very considerable increase in the mortality of their neighbourhood, it cannot be supposed possible that similar nuisances should prove less deleterious when exposed to a tropical sun, in an atmosphere so surcharged with moisture as that of Bombay, and that, too, in a town over-crowded (as regards the number of square yards to each inhabitant) *far beyond all European precedent.*

6. From the reports of the Registrar General it appears, that if we compare one million of the inhabitants of the large towns with the same number of the inhabitants of the rural districts, the inhabitants of the towns lose nearly 8,000 more every year than the inhabitants of the country (the exact number is 7,773). This is the general average of the whole of the one class as compared with the whole of the other, taking healthy and unhealthy towns, and healthy and unhealthy rural districts together. But the rate of mortality differs much in different towns and districts: for instance, on the average Mortality Returns of 1840, 1841, and 1842, as compared with the population by the Census of 1841, the general annual death-rate of the healthiest rural districts in the North of England was only 14 per 1000, and that of the healthiest towns 20 per 1,000; Halifax and Kidderminster were 21 per 1000; London 25 per 1000; Preston 29 per 1000; Hull and Leicester 30 per 1000; Bristol 31 per 1000; Manchester 32 per 1000; and Liverpool 35 per 1000.

7. The Registrar General's reports also show the effects of the unhealthiness of towns on the average duration of life: the inhabitants of London lose eight years of their lives, as compared with the population of the rural districts, and the inhabitants of Liverpool eighteen years. The unhealthiness of a town increases the mortality of the infant population in a very much higher *ratio* than that of the adults. If we compare the healthier rural districts of England with the Metropolis, it will be found that in the former localities children under five years die at less than double the average rate for all ages, and in London at more than four times that average; in other words, if the population be divided into two classes as regards age, the first consisting of all aged above five years, and the second of infants under five, it will be found that in the healthier districts, the mortality of the first class is only 12 per 1000, and that of the second 26 per 1000; but that in London the

death-rate of the first class is 15 per 1000, and that of the second 107 per 1000. In English towns and districts, children under five years constitute from one-seventh to one-ninth of the entire population; in Bombay, the proportion of infants is probably very much less.

8. All parts of large towns are not equally unhealthy : amongst the inhabitants of first class houses in first class streets, the annual death-rate is as low as 18 per 1000, and in the worst class streets and houses as high as 40 per 1000; in confined alleys and courts reaching even 54 per 1000. In Bombay, the difference between the death-rate in the healthiest and most unhealthy districts is considerably greater : this may be perhaps attributed to the greater density of our population, a circumstance always found to increase very greatly the mortality of undrained districts.

9. It being thus rendered apparent that the annual death-rate of large towns very greatly exceeds that of rural districts, the question naturally suggests itself—What proportion of this excess is "preventable," and how many lives may be saved annually by precautionary measures?

10. The sanitary statistics that have been so industriously collected in England since 1838 afford data for answering this question most satisfactorily. "I have no hesitation," says Dr. Simon, one of the Surgeons of St. Thomas's Hospital, and the Medical Officer of Health to the City of London, in his last year's (1850-51) Report on the Sanitary Condition of the City of London, "in renewing an assertion of my last year's report, that *if the deliberate promises of science be not an empty delusion, it is practicable to reduce human mortality within your jurisdiction to the half of its present average prevalence.*"

11. In another portion of the same report, Dr. Simon says: "I need not inform your Honorable Court, that this death-rate (24.480 per 1000) is unduly high. I have already in previous reports laid before you the materials for measuring its excess—materials which seem to show that our existing death-rates are nearly the double of that which better circumstances have elsewhere rendered attainable.

12. "It is not to the city alone of metropolitan districts that this high mortality belongs. Unhappily, it affects the entire Metropolis, and we may find other towns in England, and still more on the Continent, where the death-rate is higher than under your jurisdiction; yet your Honorable Court will not doubt that the standard to be adopted for your estimate of healthiness ought to be the lowest known death-rate; and every avoidable death is an unqualified evil to society; and that *if a mortality of* 12, 13, *and* 14 *per* 1000 *per annum can be reached for one mixed population, there is ample room for discontent among any other*

population which finds itself doomed to perish at double the rate of the first."

13. The excessive mortality of ill-conditioned towns can be proved to be due in every case to some or all of the following causes: deficient sewerage; low and damp situation; over-crowding; defective ventilation; deficient scavenging; defective water supply; *ill-devised arrangement of dwelling-houses;* the practice of offensive and injurious trades; the putrefaction of intramural burial-grounds; and the like; all of which causes of increased mortality ought to be—and few of which are—provided against by our local enactments. At present, I shall only consider the amount of "preventable deaths" due to the first of the above causes—the want of covered street-drainage.

14. I have already alluded to the sanitary movement in England as having supplied authentic data for determining the causes of the excessive mortality of towns, and the best means of prevention. I shall now proceed to give a rapid sketch of the origin and progress of this movement, and of its practical results in the three-fold improvements it has effected: *first* of all, in the legislative enactments relating to the subject; *secondly*, in the admirably organized system of municipal establishments which have since been introduced in most large English towns; and *thirdly*, in the great reduction in the cost of works and town-drainage that has resulted from the experimental works of the Parliamentary Commissioners.

15. The sanitary movement in England originated in the reports of the Poor Law Commissioners, and may be said to date from 1838. In that year, Drs. Southwood Smith, Arnot, and Kay, acting under the Poor Law Commission, first directed attention to the deplorable condition of the districts of the Metropolis inhabited by the poorer classes, and to the ravages of fever and other fatal diseases in these localities. These inquiries were followed up by a Committee of the House of Commons in 1840; then again by Mr. Chadwick, who, also acting under the Poor Law Commission, having carried on still more extended investigations during the years 1840 and 1841, presented the results in the Sanitary Report of 1842. In 1843 the Queen appointed Commissioners "to make further inquiries into the actual state of large towns and populous districts, and to devise the best means of promoting and securing the public health."

16. Their first report was published in 1844, and it has been followed by others of equal value. The Metropolitan Sanitary Commission was appointed in 1847, and the first of their series of blue books appeared at the close of the same year. The General Board of Health in 1849 and 1850 issued voluminous reports on the water supply, and on the measures adopted for the execution of the "Nuisances Removal and

Diseases Prevention Act," and the "Public Health Act;" and several supplementary reports on various subjects connected with the public health, prepared by Mr. Chadwick (now a C.B.) and others at the request of the Secretary of State, have been published by order of Parliament.

17. The importance which the English Government attached to these inquiries was evinced by a paragraph in the Speech from the Throne at the opening of the Sessions of 1845, and by the Queen's rewarding those who had taken the most active part in the inquiry with the ribbon of the Bath.

18. The movement made as much progress out of doors as in Parliament. In the Metropolis an association was formed "for the purpose of diffusing a knowledge of the circumstances that injuriously affect the health and lives of the inhabitants of towns, and of the means by which the one may be preserved, and the other protected."

19. Amongst the Committee of this association were the Marquis of Normanby, B. D'Israeli, Sir E. L. Bulwer, Lord Ebrington, Lord Ashley, Sir R. H. Inglis, Lord J. Manners, Lord Francis Egerton, Lord Robert Grosvenor, Lord Morpeth, R. Lalor Sheil, half a dozen Bishops and Deans, Lord Dudley Stuart, Lord Lovelace, and most of the Members of both Houses of Parliament who had shown any interest in the welfare of the masses. There were also amongst them several eminent practical men—engineers, architects, and physicians; amongst the latter Sir J. Clarke, Dr. Southwood Smith, Dr. J. Simon, and Dr. Guy. With the same object, similar associations were formed in the principal towns, and the working classes (the principal sufferers by the neglect of sanitary measures) formed among their own body an association for the same purpose.

20. A strong proof of the hold which this great movement had taken on the public mind was afforded by the fact of Lord Ebrington assuming the office of lecturer, and becoming a public teacher of the important truths revealed by the labours of the Health of Towns Commission.

21. The practical utility of Royal Commissions and Parliamentary Committees has often been doubted, on the ground that the blue books to which they give birth, though frequently exposing the existence of very serious evils, usually only suggest remedies which under the circumstances are either impracticable, or which present so many difficulties in execution as to render it highly improbable that they should be even carried into useful effect. This was, however, not the case with the inquiries of the Health of Towns and Sanitary Commissions. The Committee of the association I have mentioned above delivered in 1846 the following opinion regarding the value of these reports:—

22. "The result of these various inquiries has been the collection of

a body of evidence of the highest order, relative both to the extent and intensity of the evils in question, and to the proper legislative remedies; and the publication of this evidence will, in the opinion of your Committee, form an era in the history of legislation, there being no other instance known to them in which evils of so much magnitude have been proved to be so generally prevalent; in which the search after efficient and permanent remedies has been attended with a success so unquestionable and so unquestioned; in which the mode of giving practical effect to those remedies has been so satisfactorily shown; and, consequently, in which so much has been done, at once to guide the legislature, and to instruct and prepare the public mind for cordial co-operation with it."

23. This encomium on the practical character of these inquiries has been fully justified by their results, the first and most important of which was the passing of a series of admirably devised general and local Acts of Parliament for facilitating the prevention of disease and nuisance, the regulation of buildings, and the construction of drains in large towns, and also for constituting the machinery and organizing the establishments by which these desirable objects were to be carried out in each locality. In 1844, the Metropolitan Building Act was passed, a similar Act for the regulation of buildings in large provincial towns having been previously introduced by Lord Normanby; Lord Lincoln's Sewerage and Drainage, &c. of Towns Bill was introduced in 1846; the "Nuisances Removal and Diseases Prevention Act" became law in 1847; and the "Public Health Act" was passed about the same time; and in 1848 an Act to amend the Nuisance Removal, &c. Act was introduced. Numerous supplementary local Acts of Parliament were also passed for meeting the peculiar requirements of particular towns in respect to the regulation of buildings, and the prevention of nuisances.

24. It was stated in paragraph 14 that the improvements resulting from the sanitary movement in England had been three-fold; 1*st*, as regards the legislative enactments on the subject; 2*nd*, in respect to the organization of the municipal establishments for carrying out the former; and 3*rd*, in the constructional details of works of sanitary engineering. Having shown its effects in the improvement of the legislative enactments on the subject, I shall now proceed to give a sketch of the improved system of municipal establishments it was the means of introducing, and which is now generally adopted in most large English towns.

25. In Bombay, as in all other large towns which possess a revenue, and maintain establishments for the purpose of promoting the health and convenience of the inhabitants, such establishments have three distinct functions, which are performed under three distinct local Acts.

The 1*st* of these functions is that of an executive engineer's establishment, namely the design and construction of new roads and sanitary works, and the repair and maintenance of the old ones. This is done at Bombay by the Superintendent of Repairs,* under Act No. XI. of 1845, and the annual amount of such executive expenditure is about equal to that of the whole road and tank department. The 2*nd* is "the regulation of buildings." This is effected by the Surveyor to the Court of Petty Sessions, under the Building Act, No. XXVIII. of 1839. The 3*rd* is the prevention of nuisance, and this is also done by the Surveyor to the Court of Petty Sessions, under the Nuisance Act, No. XIV. of 1842.

26. In large English towns, the executive engineering work of the municipality, the regulation of buildings, and the enforcement of the Nuisance Act, are effected by three distinct municipal officers, having distinct establishments and distinct duties. The *first* of these is styled differently in different towns either "Borough Engineer," or "Engineer to the Committee of Health," &c. However styled, the duties of this officer are in all cases solely those of an executive engineer.

27. *Secondly*, a public officer is appointed, called the "Inspector of Nuisances," armed with sufficient power "to enforce obedience to the law," and "provided with a distinct establishment for the purpose."

28. *Thirdly*, a "Surveyor of Buildings" is appointed, provided with powers and establishment adequate to the enforcement of the local Building Acts, which in England are always very much more stringent than in Bombay, a circumstance to which the greater regularity of streets and buildings in English towns is to be attributed. The Surveyor of Buildings and his establishment is principally remunerated by fees, varying in amount for the various classes of buildings; if the town is large, it is divided for the purposes of the Building Act into separate districts, and a Surveyor of Buildings appointed to each.

29. In most large English towns there is a fourth functionary appointed—"A skilled and responsible medical officer," called the "Medical Officer of Health"; his duties are "to ascertain the true causes of disease and death, and more especially of epidemic diseases, in the various districts of the town."

* The Superintendent of Repairs is appointed by the Bench, subject to the approval of Government, who confirm his appointment only on the condition of his discharging the duties of a Government appointment, that of Surveyor to the Court of Petty Sessions, "gratuitously." This arrangement being made, the Superintendent of Repairs is forthwith gazetted as "appointed by the Governor in Council Surveyor to the Court of Petty Sessions," his establishment in such capacity being still paid from the treasury, and not from the Municipal Fund. The inconvenience that would otherwise arise from the double capacity of the Surveyor to the Court and Superintendent of Repairs, and the double authority under which he acts, is in great measure obviated by the Court of Petty Sessions and the Board of Conservancy having the same Chairman.

30. The system of annual sanitary reports now usually adopted in most large English towns is attended by great advantages. It is as follows:—The Borough Engineer, the Inspector of Nuisances, and the Medical Officer of Health, each forward annually to the supervising body (corresponding to the Board of Conservancy at Bombay) a report of the present sanitary state of the town, and of the progress of improvement during the past year, as far as regards his own particular department. These reports are printed, and handed up by the supervising board, with any comments it has to make on them, to the higher authority.

31. These reports are most valuable, in diffusing amongst the public a well-informed interest in the sanitary progress of the town. They contain a concise and intelligible exposition of its present sanitary state, and past year's progress; every statement being supported by the authority of figures and statistics, (the actual rate per foot or yard at which each improvement or repair has been effected is given and compared with the corresponding rate in former years, and with that given for similar work in the similar reports of other municipalities,) the still existing sanitary deficiencies of the town are pointed out, with the remedies proposed. Any improvement effected in the machinery for the enforcement of the Building and Nuisance Acts is detailed, and any deficiencies in the enactments of either Act that have manifested themselves during the experience of the past year are pointed out, and codicils to the Act suggested to remedy them.

32. I now come to the third species of improvements that has resulted from the inquiries of the various royal commissions, and from the experimental works of the recently appointed "Consolidated Commission of Sewers for the Metropolis." These improvements principally consist in the adoption of a new form of section, "the oviform" (much more economical and effective than the old one), for large and middling-sized sewers, and of "tubular drains" of glazed stone-ware for the smaller ones, the course of the drainage being at the same time rendered as short and direct as possible, and the section of each drain being proportioned to the amount of sewerage it is required to carry off. The economical result of these improvements is thus stated in one of the reports of the General Board of Health in 1850:—

33. "The late George Stephenson reported upon the drainage of Carlisle, and estimated the expense of street sewers at upwards of £70,000: upon the recent investigations of our Engineering Inspector, Mr. Rawlinson, it is estimated that the whole city may be far more efficiently drained for £10,000. At Southampton, the expense of draining the town had been put at upwards of £51,000; our Engineering Inspector, Mr. Ranger, calculates that on the improved plan it may be

accomplished for £26,000. A very complete plan, with some improvements, had been laid out for Reading, at an expense £60,000; our Engineering Inspector, Mr. Lee, is confident that the improved drainage works, including complete house-drainage, may be executed for little more than £25,000."

34. The improved system of municipal establishments, sanitary enactments, and sanitary engineering, now generally adopted in large English towns, will be described at greater length, and the applicability of such improvements to the peculiar circumstances of India and Bombay examined, in the Appendices to this Report; I shall at present proceed to point out the causes which have been proved by the sanitary inquiries instituted in England to increase the mortality of the inhabitants of towns, and shall endeavour to show that similar causes produce similar effects in Bombay also.

35. Dr. Southwood Smith, the Physician to the London Fever Hospital, a Member of the Sanitary Commission and General Board of Health, and distinguished for the leading part he has taken in the sanitary movement, in speaking of the effect of sanitary improvements (drainage particularly) in diminishing the mortality of towns, says:—"The records of the London Fever Hospital prove indubitably that there are certain localities in the Metropolis and its vicinity which are the constant seats of fever. * * * The districts in which fever prevails are as familiar to the physicians of the Fever Hospital as their own names.

* * * * * *

36. "In every district in which fever returns frequently, and prevails extensively, there is uniformly bad sewerage, a bad supply of water, a consequent accumulation of filth; and *I have observed this to be so uniformly and generally the case, that I have been accustomed to express the fact in this way: if you trace down the fever districts on a map, and then compare that map with the map of the Commissioners of Sewers, you will find that wherever the Commissioners of Sewers have not been, there fever is prevalent, and, on the contrary, wherever they have been, there fever is comparatively absent.*"

37. The data afforded by the census and mortality returns of Bombay prove that Dr. Smith's remark applies to this town as stringently as to London. The Police Surgeon, Dr. Watkins, has recently made a report to the Medical Board, which has been forwarded through Government to the Board of Conservancy, on the ratio of annual mortality (from cholera) among the population of the various police divisions of the island. It is to be regretted that the tables illustrating this report are not calculated for less extensive districts than the great police divisions, some of which contain a population of more than 100,000, and include well-drained as well as undrained districts; yet, notwithstanding

this, the result is sufficiently remarkable. The ratio of last year's cholera deaths to population was, in the A Division, containing the three sub-districts of the *Fort*, the Esplanade, and Colaba, as compared with that of the E Division, containing Mazagon, Tarwary, *Cammatee Poora*, Parell, and Sewree, only as 4 to 14. Dr. Watkins correctly attributes this excessive mortality of the E Division to the circumstance of the filthy sub-division of *Cammattee Poora* falling within it; and "to no one," he remarks, "who is acquainted with the situation of that district, can it be a matter of surprise that such should be the case, the imperfect drainage, the filth and poverty of the population, and the presence of a wide uncovered drain close to this part of the town, rendering it only to be wondered at that disease is not more virulent."

38. The comparative mortality of the A and E Divisions gives, however, no adequate idea of the *extreme* difference between the mortality of the drained and undrained districts of the island. The A Division, though it includes the Fort, the drainage of which is *entirely* covered, and which is consequently by far the healthiest sub-division of the island, contains also the Esplanade sub-division, which is rendered unhealthy by the bad smells of Back Bay, and the ill-conditioned sub-division of Colaba. On the other hand, the E Division contains the rural and consequently healthy sub-divisions of Parell and Sewree, as well as the undrained and unhealthy sub-divisions of Cammattee Poora. Were the annual death-rates of the Fort and Cammattee Poora sub-divisions alone contrasted, the difference would be far more striking.

39. Ever since the first census and mortality returns were taken in Bombay, I have analysed, compared, and tested them in all possible ways, and constructed, from the data they afforded, detailed tables regarding the ratio of mortality to population in each police *sub-district* of the island; but these tables are rendered comparatively valueless by the extreme inaccuracy of the census, which, under the manipulation to which I have subjected it, discloses discrepancies palpably incompatible with the truth. The *mortality returns*, indeed, may be trusted, except for infants, many of whom are buried in compounds, without their deaths being reported to the police; and I have reason to believe that the TOTAL of the population of Bombay is pretty correctly stated in the last census at 510,000. I have arrived at this conclusion by comparing the mortality returns of Bombay with those of London, and assuming that the general death-rate of the former will be to that of the latter in the same ratio which that of the Native troops of Bombay (which is accurately known) bears to that of the English troops in London.*

* The annual proportion of deaths to population in the various European States is as follows:—

In England, 21·73 per 1000; Denmark, 22·22 per 1000; Russia in Europe, 22·73 per 1000;

40. But though I have thus reason to believe that the *total* of the last census is not far from the truth, the details exhibit some palpable impossibilities. The Parsees, for instance, have evidently greatly exaggerated their numbers, probably more than doubled them. No doubt can attach to the correctness of the police returns of Parsee deaths, yet these are at the rate of only 7¼ per 1000 per annum on the *alleged* Parsee population, a death-rate far too low to be possible in any country in the world, being only about half the death-rate of the healthiest rural districts of the North of Europe.

41. In the last tables I framed of the death-rates of the different police sub-divisions of the island, I took the census of 1850-51 as the standard for population, because that census was the lowest, and the

Belgium, 23·81 per 1000; Norway and Sweden, 21·38 per 1000; Austria, Portugal, Spain, and Switzerland, 25·00 per 1000; Prussia, 25·64 per 1000; Turkey, 33·33 per 1000.

The difference in the general death-rate of these countries is principally due to the difference in the infant mortality of each. The death-rate of the adult male population, between 18 and 60, has a much narrower range, and does not depart materially from 10 per 1000 in any European State.

The mortality of the armies of Europe and the United States seems rather proportionate to the amount of work exacted from each, and to the class of men that compose it, than to the general death-rate of their respective States.

It is singular, however, that even in time of peace, and in the lightest worked and best cared for armies, the death-rate is considerably higher than that of the similarly aged civil population.

The Prussian army loses annually 11·7 per 1000; the similarly aged civil population of Berlin only 10 per 1000; British Army (average) 37 per 1000; ditto serving at home, 15 per 1000; ditto serving abroad, 57 per 1000; French army, 34·7 per 1000; ditto exclusive of officers, 46·5 per 1000; Russian army, 50 per 1000; ditto in Caucasus, 160 per 1000; United States army (average) 44 per 1000; ditto serving in Northern States, 18 per 1000; ditto in Southern States, 44 per 1000.

The low death-rate of the Prussian army can be accounted for: it is the best educated army in Europe; it is composed of young men only engaged three years in active service, and it suffers little from being removed from place to place. On the other hand, the army of the United States, which consists of only 5,515 men, doing duty in a territory nearly as large as Europe, is very much knocked about, and being, moreover, composed of Irish of the lower class, who take no sort of care of themselves, it loses four times as many per 1000 as the Prussian army. The extraordinary loss which has always been experienced by the Russian troops on field service is attributed to their defective commissariat arrangements.

One of the most singular circumstances connected with the vital statistics of European armies is that the infantry loses nearly twice as many men per 1000 as the cavalry: thus in the British army, from 1830 to 1836, the dragoons lost annually 14 per 1000, and the infantry 26·6 per 1000; the horse guards lost only 31·3 per 1000 during a period of time in which the foot guards lost 56 per 1000. The Piedmontese forces, on the average of more than 20 years, experienced a mortality of 18 per 1000 in the cavalry, and 34 per 1000 in the infantry.

In the Prussian army (the healthiest in the world) the infantry lose 12·9, the cavalry 9, and the artillery 10 per 1000 per annum.

I am not aware whether this difference between the death-rate of cavalry and infantry is found to obtain in India.

second one taken; but as we had a visitation of cholera that year, I took the death returns of 1849-50 as the standard of average mortality. In the tables framed on these data the death-rate of the Fort (the only district we have which is *altogether provided with covered drains*) is only 9·9 per 1000, while that of some of the sub-divisions of the Native Town is as high as 60 per 1000, or somewhat more than the death-rate of similar localities in Liverpool. Even assuming that the Parsees in the Fort had returned their number at twice its real amount, and that something more than a third must on that account be subtracted from the total alleged population of the Fort, the death-rate in that sub-division would still be under 14 per 1000, or *less than a quarter of the death-rate* of the unhealthiest of the undrained districts; and this is exactly the difference found to exist between the death-rates of the worst and best conditioned streets in English towns.

42. The greater portion of excessive mortality of ill-conditioned town districts is certainly due to many other causes besides the deficiency of covered drains; but the sanitary statistics of English towns show with sufficient exactness that a large and specific amount of such excess (20 per cent.) is attributable to this cause alone. I will adduce the authority of Mr. Holland's Report on the Sanitary Condition of Charlton-upon-Medlock regarding this point. Mr. Holland's results are fully confirmed by Mr. Gardener and Mr. Noble's reports on the sanitary condition and mortality returns of certain streets in Manchester before and subsequent to their drainage; but I have selected Mr. Holland's report as being the most careful and elaborate of those I can at present lay my hands on.

43. *Extracts from a Report on the Sanitary Condition of Charlton-upon-Medlock, by* H. P. Holland, Esq., *extracted from the Report on the State of large Towns in Lancashire, by* Dr. Lyon Playfair.

"In order to answer the question, 'What is the general condition of the district with respect to health?' upon sure grounds, I have undertaken a very laborious examination of the condition of every street and court of the district; and next, have ascertained the rate of mortality in each during the five years ending June 1843. I first obtained from the books of the assessors of the poors' rate the number of occupied and unoccupied houses in each street, and their rent; I next visited each street, and took notes *on the spot* of its condition as to paving, cleansing, sewering, and free circulation of air, or otherwise; of the general condition of the dwellings with respect to cleanliness, dampness, or dryness, and supply of water; whether or not they had back doors, yards, privies, &c.; and remarked upon any other circumstances which

caught my attention as likely to influence the health of the inhabitants. These observations I compared with information kindly furnished by Mr. Langtry, the District Surveyor, and other public officers, as well as from the inhabitants themselves, and from the result classified the streets into nine such divisions: first, into three divisions as respects the streets themselves—the best, intermediate, and worst-conditioned classes; next each of these into three sub-divisions, according as the houses were of the first, second, or worst class.

44. "The first class of streets includes those of the town part of Charlton-upon-Medlock, which are completely paved and sewered, regularly cleaned, are thoroughfares, and wide enough to admit of a free circulation of air.

"The second or intermediate class are such as are unpaved and imperfectly drained, but still kept clean and tolerably dry, as well as such as, though paved, are too narrow and confined to admit of a free circulation of air.

"The third class are those which are not paved, not sewered, not cleaned, and not well ventilated, and are often little better than courts.

45. "The sub-divisions are made according to the houses—

"The first class of which are those of ample size, provided with yards, lobbies, and kitchens, are well supplied with water, and which have nothing about them attracting notice as likely to be injurious to health.

"The second class includes the better sort of cottages, those that have back doors, and those larger houses which, being closed behind, or on damp soil, or badly supplied with water, cannot be considered quite unobjectionable.

"The third class includes those streets where the majority of the dwellings are without back doors, without yards and privies, without a proper supply of water, or have some other very evident defect.

46. "I next undertook an analysis of the deaths registered as occurring in the district during the five years ending June 30th, 1843, and ascertained how many deaths have occurred in each of the streets during that period.

47. "In order to avoid the possibility of unconsciously warping the result, I completed the classification of the streets *before* I knew what were their rate of mortality. The two inquiries were completed separately, and the results compared afterwards. Many of the streets have been paved and sewered during the five years; these have been placed in two classes; in the class in which they were before their improvement during the time they remained unimproved, and in the class to which they now belong during the years subsequent to their improvement.

48. "The following tables exhibit the rate of annual mortality in

the different classes of streets and houses of the town part of Charlton-upon-Medlock, in the average of the five years ending June 1843 : —

"TABLE A,

Exhibiting the Rate of Mortality in different Classes of STREETS, *the Houses being of all Rates.*

Classes of Streets.	Rate of Mortality.	Excess per Cent. above First Class Streets.
Streets of 1st Class....	2·2 per cent. or 1 in 46	..
„ 2nd Class....	2·6 „ „ 1 in 39	18
„ 3rd Class....	3·7 „ „ 1 in 27	68

"TABLE B,

Exhibiting the Rate of Mortality among the Inhabitants of different Classes of HOUSES, *the Streets being of all Classes.*

Classes of Houses.	Rate of Mortality.	Excess per Cent. above First Class Streets.
Houses of 1st Class ...	1·9 per cent. or 1 in 52	....
„ 2nd Class....	2·5 „ „ 1 in 40	About 31
„ 3rd Class....	3·4 „ „ 1 in 29	„ 78

49. "From comparison of these tables, it would appear that the rate of mortality is more influenced by the class of houses inhabited than by the condition of the street; for we find that the mortality in the first, second, and third classes of streets, the houses being of all classes, has been in the proportion of 100, 118, and 168; but in the houses of the first, second, and third classes, the streets being of all classes, that the proportion of mortality has been 100, 131, and 178; there is, therefore, a greater difference in the rate of mortality among inhabitants of different classes of houses than in those of streets of different condition. When, however, the evil influences of both badly constructed dwellings and badly conditioned streets operate together, the destructive effect is very striking. For instance, the third class houses of the first, second, and third class streets are nearly alike in construction, are about the same size, are charged about the same rent, and are inhabited by about the same class of persons; but the rate of mortality in the third class houses in the first and second class streets has been 2·7 and 2·8 per cent. respectively, while in those of the same class of houses, but in the third class streets, the rate has been 4 per cent., or a higher rate of mortality, in the proportion of 10 to 7. *I am aware of no circumstances but those*

connected with the bad condition of the streets which will account for this great difference.

50. "It may be thought that these streets are inhabited by a poorer class than the others, but I do not believe that is the fact, except so far as their poverty is increased by the expenses of sickness and death in their families, and by consequent loss of work. Their incomes *while at work* must be much the same, for they have the same sorts of employment. *There seems every reason to hope, that if these worst streets were put into good condition, the rate of mortality would fall* 25 *per cent. or more. The diminution in the rate of mortality has been nearly* 20 *per cent. in the streets which have been improved as before stated:* it has fallen from 3·1 per cent. or 1 in 32, to 2·53 per cent. or 1 in 39. *The effect of a permanent good condition, as we have just seen, appears to be still more beneficial;* and there can be no doubt that if the houses, as well as the streets, were put into proper condition, the rate of mortality would fall still more. It is, indeed, unreasonable to expect that the general state of health and longevity of the poor can be raised as high as that of those in more comfortable circumstances, by any, even the best, sanitary arrangements; but I think the evidence here adduced distinctly shows that the rate of mortality *among the poor certainly, among all classes probably,* is unnaturally high, from the operation of removeable causes of disease.

51. "When we find the rate of mortality four times as high in some streets as in others, and twice as high in whole classes of streets as in other classes, and, further, find that it is all but *invariably high in those streets which are in bad condition, and almost as invariably low in those whose condition is good, we cannot resist* the conclusion, that multitudes of our fellow creatures, *hundreds of our immediate neighbours, are annually destroyed for want of the most evident precautions.*"

52. All undrained streets are not in an equally bad condition. *The amount per cent.* by which the death-rate of a street would be reduced by draining it depends of course on whether the former state of such street was rather bad only, or very bad indeed; it also depends on the density of population, as over-crowding is found very much to increase the ill consequences attendant on the want of drainage. I shall now therefore show—1*st*, that open drains, or rather receptacles for filth, abound in the Native Town of Bombay to an extent I believe to be unparalleled elsewhere; and 2*nd*, that in most divisions of the Native Town our population is over-crowded beyond all English precedent; and for these two reasons, I think, we may confidently expect that in Bombay the drainage of undrained streets will be attended by a much larger reduction in the death-rate than has been found to result from similar improvements in England.

53. The open drains, or rather uncovered receptacles of filth that I have alluded to, are the open side gutters, by which nearly every street in the Native Town is polluted. These do not deserve the name of drains: there is seldom any perceptible motion in the liquid contents of the majority of them; they are merely an interval of from one to two feet in width, left between the kerbstones of the streets and the foundations of houses; they are not regularly sloped, but follow the inclination of the several streets; they are not paved at the bottom, and the scavenger's people, in cleaning out with their shovels any solid matter that may have been thrown into them, constantly stir and scrape up the mud beneath, so as still further to increase the irregularities of their channels, and render them still more unfit for the performance of the functions of a drain. These side gutters can, therefore, only be considered in the light of continuous open cesspools, extending along (on both sides) the whole length of nearly every street in the Native Town, and rendered (irrespective of their greater extent) more objectionable than ordinary cesspools, by the circumstance of their being in actual contact with, and soaking into the foundations of, the whole street-frontage of each house.*

* It will be remembered that four years ago the *Girgaum* and *Kalbadavee* roads, the *two* principal thoroughfares of the Native Town, and those most frequented by Europeans, were still polluted by these open side gutters; and though covered drains have since been substituted in these two particular streets, such improvement has, owing to the deficiency of funds, made very little progress in the back streets of the Native Town.

N. B.—This note was written in 1852, (date of report 31st March 1852,) and I am happy to state that the open side gutters therein complained of have since almost entirely disappeared.

This improvement is due to the increased rate of progress in drainage that has been brought about by the adoption (as far as local circumstances permitted) in 1852 of the improved system of drainage elaborated by the expriments of the English Board of Health and the Sanitary Commission, and described in the "Minutes of Information on Town Drainage" that were published in the preceding year. The effect of these improvements has been to diminish the cost of street drainage in Bombay to one-half its former amount, and the diminution of cost is accompanied by a great increase in efficiency, owing to the improved scour in the sewers, due to their smaller size, their improved cross-section, and their more direct course.

In the season of 1852-53, 87 streets and roads were thoroughly drained on the new system, and the drainage of the Old Town thereby completed. During the next season the two blocks of the New Town, situated between Bhendy Bazar Road, Duncan Road, Erskine Road, and Bellasis Junction Road, containing 29 streets, were thoroughly drained; and in addition to these, the suburb of Small Colaba, and five other streets in different parts of the town, were drained during the same season. I have prepared and sent in detailed estimates and plans for the drainage during the present season of the Sonapoor District (containing 14 streets), of Commattee Poora (containing 18 streets), of Khetwaddy (containing nearly 20 streets), and the remaining portion of the New Town situated between Duncan Road, Trimbuck Furrusram Street, Coombarwada, and Grant Road, and containing 13 streets. The construction of all these has been sanctioned by Government, but their execution has been delayed by a deficiency in the municipal revenue, occasioned by the discovery of a flaw in the Act for collecting the shop and stall tax. When the improvements already sanctioned are

54. The evils arising from cesspools or open receptacles of filth of even ordinary extent and position is thus stated in the First Report of Her Majesty's Commissioners for inquiring into the state of large Towns and Districts (Vol. I. page 17):—"The medical witnesses have brought before us facts in support of their strongly urged and unanimous opinion, that *no population can be healthy which live amid cesspools, or upon a soil permeated by decomposing animal or vegetable refuse, giving off impurities to the air in their houses and in the streets.*" In their Second Report they add (Vol. I. page 111):—"Many instances occur, where the walls of the adjoining houses *are constantly wet with fœtid fluid, which frequently affects the atmosphere of the rooms so as to render it impossible to keep food for one single night without its becoming tainted. The walls of the house receive considerable damage, and the foundations are completely saturated with the foul water that percolates through from the cesspools. The deterioration of property from this cause is very considerable.*"

It is also stated in evidence, that the springs and wells are constantly polluted by the same cause. "As houses are built, and *neighbourhoods become* MORE CROWDED," says Mr. Joseph Quick, (First Report, Vol. II. page 117,) "the pollution of the springs by the permeation of water from cesspools becomes greater."

55. I have already said that the energy with which the miasma arising from uncovered drains acts on the inhabitants of town districts is always found to be proportionate to the density of the population: an open drain which would not augment the death-rate of a thinly inhabited district by 3 per cent. is often found to increase that of an over-crowded neighbourhood by upwards of 30 per cent. Thus, in one of the reports of the Registrar General, the districts of the Metropolis are divided into three groups, of ten districts each, under the titles of the *healthiest*, *medium*, and the *unhealthiest* districts.*

completed, the drainage of the town will be so also, with the exception of the Oart District, a district which has become irregularly and very densely covered with houses, without ever having been laid out into streets, or intended for a town; the whole, therefore, form a labyrinth of very crooked, irregular, narrow, and filthy alleys; and an Act of legislature for obtaining the ground required for streets in this district must be obtained before anything can be attempted towards its drainage.

* I have extracted this table from the chapter on the causes of high mortality in town districts, commencing at page 406 of the Fifth Annual Report of the Registrar General. The whole of this chapter is very curious. From the vital statistics of certain districts of the Metropolis, the general laws are deduced (and expressed in algebraical formulæ), which regulate the action of these various causes on the rate of mortality. These formulæ are then tested, by comparing the results, as calculated by the formulæ for other districts with the actual results of direct observations in the same districts; and the coincidence of the calculated results, and results of direct observation, is very remarkable. For instance, the Registrar General says: "In endeavouring to estimate the effects of density of population in districts, I shall, to

56. The ten *healthiest* districts, with an allowance of 202 square yards of space to each person, have a mortality of 20·4 in 1000.

The ten *medium* districts, with about half the space, viz. 102 square yards, lose 24·4 in 1000.

While the ten *unhealthiest*, with the allowance of 32 square yards to each inhabitant, have a mortality of 27·8 per 1000.

simplify the inquiry, take examples from the observations on females. [The female mortality of an English town district is considered a surer criterion of its sanitary state than that of the males, because the latter class, owing to the nature of their daily avocations, are generally absent from the districts, in which their families reside for the greater portion of the 24 hours.]

" I take three from the class of districts in which the mortality is highest—Whitechapel, Shoreditch, and Bethnal-Green. They are inhabited by very much the same class of people; the sewerage and supply of water is nearly the same; the value of assessed property is greatest in Whitechapel, less in Shoreditch, least in Bethnal-Green; but the density is different, and the mortality is highest in the densest districts. Until the expectations of life have been calculated, the mortality may be employed.

Districts.	Annual Mortality of Females. (m)	Population to a Square Mile. (d)
Whitechapel	·02978	127,313
Shoreditch	·02790	86,123
Bethnal-Green	·02617	62,390

The mortality was for the four years 1838 to 1841. The mortality of males, and several other facts, are given in tables, pp. 448, 449.

It will be observed that the density of population is half as great again, and the mortality one-fifteenth part higher in Whitechapel than in Shoreditch; so that the mortality does not increase in the same ratio as the density; and representing the density of the densest district (Whitechapel) by d', that of the least dense (Shoreditch) by d; the mortality of the densest district (Whitechapel) by m', that of Shoreditch by m, the proportion does not hold:—

$$m' : m :: d' : d$$

Upon reducing the terms to the form of an equation, it will be seen that the mortality increased as the sixth roots of the densities; for

$$\frac{m'}{m} = \sqrt[6]{\frac{d'}{d}}\text{; and consequently } m' : m :: \sqrt[6]{d'} : \sqrt[6]{d}$$

We have then the formula $m' = \sqrt[6]{\frac{d'}{d}}\, m$, which is the mortality of Whitechapel, expressed in terms of the mortality of Shoreditch, and the densities of Shoreditch and Whitechapel. By substituting the number expressing the mortality of Whitechapel, and the densities of Whitechapel and Bethnal-Green in the formula, the equation is $\sqrt[6]{\frac{62390}{127313}} \times ·02978 = ·0264$ for the mortality of Bethnal-Green, the mortality given by direct observation having been ·0262.

He then applies the formulæ to other districts, and the same coincidence between calculated and actual results obtains throughout. He concludes his remarks on *this particular cause of high mortality* as follows:—" In a complicated question of this kind it would be premature

57. In the table below, I have given in juxtaposition to the above the names of the six police sub-divisions which constitute the Native Town of Bombay, with the number of square yards per individual inhabitant in each. From this table it will be seen, that the density of population in the most thinly inhabited of these sub-divisions is more than double that of the most thickly inhabited districts of London, and that the density of population in three of the six sub-divisions of Bombay is about four times that of the most over-crowded districts of the English Metropolis, and that the mean density of population in these districts is thirteen times that of London.

58. Poverty being also a predisposing cause to the class of diseases prevalent in ill-conditioned town districts, it will be instructive to compare the ratio of annual rental to population in London and Bombay, allowance, of course, being made for the difference of climate, and cost of living in each instance. I have, therefore, included in the table the average annual rental per head in London and Bombay respectively.

59.	In London.		In the Native Town, Bombay.	
		Sq. Yds. per each Person.		Sq. Yds. per each Person.
Density of population. Average square yards of space to each person.	In 10 healthiest districts	202	Khara Tulao	20½
	In 10 medium do.	102	Market	16
	In 10 unhealthiest do.	32	Bhooleshwur	10½
			Mandavee	8½
			Oomerkharee	8½
			Dhobee Tulao	8

Average annual rental to each person, in London Rs. 61 ; in Bombay Rs. 6-9-5 ; or nearly ten times greater in London than in Bombay.

The population of London was in 1841* 1,873,676, occupying 44,850 acres, on an average 115 *square yards* each. The population of the six

to assume that the mortality of towns always increases *cæteris paribus* in the ratio of the sixth roots of the densities, but the formula may now be employed as an approximation in sanitary inquiries." The whole chapter is curious, as exhibiting many instances of the application of algebraic formulæ to matters which few would have thought susceptible of such a mode of illustration.

* In 1850, the actual assessed rental of the districts subject to the jurisdiction of the consolidated Metropolitan Commission of Sewers (such jurisdiction including, with the exception of the city district, containing a population of 130,000, the whole of London and its suburbs) was £12,186,000, and the population of such districts was estimated at 2,000,000: this would make the average rental per head £6 1*s.* 10*d.* or Rs. 61, or nearly ten times the average rental per head of Bombay. I have, however, reason to believe that house property in Bombay is generally assessed considerably under its actual value. I know this to have been the case in nearly all the instances that have come under my own observation in purchasing property for public purposes. The rental per head of the city district of the English Metropolis would certainly exceed the average of the other metropolitan districts.

urban sub-divisions of the Native Town of Bombay is 337,169, occupying 6,659 acres, *or* 9·5 *square yards each, or only about one-thirteenth of the English average.*

[N. B.—I have excluded the Girgaum sub-division from the calculation, as being principally a rural district ; the density of its population (111·5 square yards per head) being little more than one-tenth of the mean density of the six above-mentioned districts.]

60. I think that the statement I have made regarding the present over-crowded and ill-conditioned state of the Bombay streets requiring drainage, and the examples I have adduced of the remarkable reduction of annual mortality always attendant on the drainage of streets in English towns not nearly so ill-conditioned or over-crowded as those of Bombay, together with the extraordinary salubrity (as compared with our other districts) of the Fort, the only completely drained town sub-division in the island, afford sufficient grounds to establish the position I advanced at the beginning of my Report, that the drainage of a street hitherto undrained has the immediate effect of reducing its annual mortality by *at least* 20 per cent.

61. I have given greater space than I otherwise should to the exposition of the sanitary reasons for pushing on the sewerage of the town as rapidly as possible, because the importance of sanitary improvements of this nature is not as yet duly recognized in Bombay. At the last meeting of the Bench, it was observed (and I had heard the same remarks in other quarters), "that the alienation to police purposes of about one-third of our present expenditure on municipal improvements would ONLY diminish the number of streets drained per annum." In fact, the general impression seems to be, that a defective police is a greater municipal evil than a defective sanitary condition : but this position is altogether untenable, for the only object of a police is the protection of life and property; and admitting that in the last thirty years some half dozen lives and a few thousand pounds' worth of property may have been lost through the insufficiency of the Bombay police to meet an emergency such as was caused by the late disturbances,* what is this to the thousands of lives which it can be proved are annually lost in Bombay "*for want of the most evident sanitary precautions ?*"

62. The apathy that prevails regarding the amount of life lost through defective sanitary arrangements is extraordinary. When attention began to be paid to these subjects in England, the public were startled by the assurance that a greater number of lives were lost every year through preventable causes of disease than the Allies lost at the battle

* There was only one life lost in the late riots, and not one was lost in the dog riots thirty years ago ; and there have been no disturbances in the interim.

of Waterloo; yet years passed before any efficient means of prevention were actually adopted. The loss of property, too, attendant on a high rate of mortality, is seldom thought of—a high annual rate of mortality is even considered by some as a wholesome check on population: but it must be remembered that a high rate of mortality can only be occasioned by premature death; that for every death occasioned by preventable causes there are, according to the best English medical authorities, at least fourteen cases of illness, more or less protracted, during which the patient is not only unproductive himself, but is a burden to the productive labour of others, and that, in fact, premature deaths presuppose unhealthy and unproductive lives.

63. I will not lengthen this Report, already too long, by quoting evidence from blue books, as I could do, to show that *sanitary reform is in itself a police improvement;* and that crime, dirt, and a high rate of mortality, are generally found to be co-extensive.* I think enough has

* "The immoral influence of filth and discomfort," says Dr. Southwood Smith, "has never been sufficiently attended to." "It is remarkable," says the same authority in another report, "*that the districts of which we have been speaking are not only the seats of disease, but the great seats of crime*—I mean these places are the haunts and abodes of the great criminals; so that the localities of the most terrible diseases, and the abodes of the great criminals of the country, are identical. The worst place I know, in the parish of Whitechapel, is the place where the most dishonest and profligate portion of the population live."

Captain Miller, the Superintendent of Police in Glasgow, in a report on the state of crime in that city, says:—"It is of great moment, *as affecting the state of crime,* that the health of the lower classes of the community be strictly attended to. In the very centre of the city, there is an accumulated mass of squalid wretchedness which probably is unequalled in any other town in the British dominions. These places are filled by a population of many thousands of miserable creatures. The houses in which they live are unfit even for sties, and every apartment is filled with a promiscuous crowd of men, women, and children, all in the most revolting state of filth and squalor. In many of the houses there is scarcely any ventilation; dunghills lie in the vicinity of the dwellings; and from the extremely defective sewerage, filth of every kind constantly accumulates. *In these horrid dens the most abandoned characters of the city are collected, and from thence they nightly issue to disseminate disease, and pour upon the town every species of crime and abomination.*

"In such receptacles, so long as they are permitted to remain, crime of every sort may be expected to abound, *and unless the evil is speedily and vigorously checked, it must of necessity increase.* The people who dwell in these quarters of the city are sunk to the lowest possible state of personal degradation, in whom no elevated idea can be expected to arise, and who regard themselves, from the hopelessness of their condition, as doomed to a life of wretchedness and crime. *Much might be done to relieve the misery, and to repress the crime of this destitute population,* by compelling attention to personal cleanliness (so as to remove and prevent disease), and, *by opening up and widening the thoroughfares, and forming new streets wherever practicable, by causing the houses to be properly ventilated, and all external nuisances removed, and by an improved plan of sewerage for carrying away all impurities. Where it is possible to adopt measures something similar to these, the health of the community would be greatly improved, and by the breaking up of the haunts of vagrancy, a happy check would be given to the spread of profligacy and crime.*"

"I have not the slightest hesitation," says Mr. Davies, speaking from ten years' experi-

been already said to show that the alienation, even for a single year, of Rs. 20,000 or Rs. 30,000, which might otherwise be spent in sanitary improvements, would occasion annually a preventable loss of life and productive labour greater than that occasioned by the riots and disturbances of the last thirty years.

64. I shall now proceed to consider the state of the Municipal Fund, with reference to the demands upon it, on account of works urgently and immediately required.

65. With the object of showing this plainly, I have compiled the tables given in the Appendices A, B, C, D, E, F, and G. It will be seen (from the margin) that these embrace all particulars of importance relating to the income, expenditure, and working system of the Board, and its executive establishment, since 1845-46. Each Appendix is accompanied by explanatory remarks, which will, I trust, render it perfectly intelligible to all. The remaining Appendices, H, I, J, and K, relate to the cleansing and drainage of the town, to its water supply, its roads, its census returns, and to the system of its municipal establishments, as compared with the system now usually adopted in large English towns.*

APPENDIX A.
Details of the Income of the Board of Conservancy, from all Sources, for each year, from 1845-46 to 1850-51, both inclusive; showing also each year's Total Expenditure, and the state of the Board's Account with Government at the close of each.

APPENDIX B.
Particulars of the Board's *General* Expenditure for each year, from 1845-46 to 1852-53, both inclusive.

APPENDIX C.
Particulars of the Board's Executive Expenditure, for the same period.

APPENDIX D.
Particulars of the Board's Establishment, for the same period.

APPENDIX E.
Particulars regarding *the Contracts for the Repairs and Scavenging of* 130 *Miles of Road for the same period.*

ence of the poorer classes, "*in* AFFIRMING *that there is a most decided direct connection betwixt confined districts, bad sanitary arrangements, and poverty and vice.* In the districts above referred to, the moral state of the inhabitants is most deplorable. As the youth from these places grow to manhood, they become habitual paupers, brought up to no regular employment, grossly ignorant, and reckless how their time is spent between the union workhouse and the jail.

"In conclusion, I can only say, that *if the Government wish to prevent the increase of a most debased and vicious population, they will take measures, if not to sweep away these nests of vice and disease already built, at any rate to prevent similar places from being erected in future.*"

The evidence of Sir Charles Shaw, Chief Commissioner of Police at Manchester, is to the same effect.

* I trust that this Report and its Appendices will supply what I have long felt to be a desideratum to those connected with, or interested in, the sanitary economy and municipal arrangements of Bombay. A great sanitary movement has taken place in England during the last ten years, and its most prominent results have been a complete revolution—1*st*, in the legislative enactments regarding the municipal and sanitary economy of towns; 2*nd*, in the machinery of boards and establishments for carrying out sanitary objects; and 3*rd*, in the constructional details of sanitary engineering. None of these various improvements have as yet extended to Bombay, and though all are aware that much reform has taken place in England,

APPENDIX F.

A List of the New Works executed, at the cost of the Municipal Fund, since the institution of the Board of Conservancy; with the mode in which such Works are let to Contract, and the Rates at which they have been executed.

APPENDIX G.

Rough Estimate of the probable Cost of certain Public Improvements, urgently and immediately required for the Improvement of the Island.

APPENDIX H.

A Comparison between the different Modes of Conveying away and ultimately disposing of Night-soil adopted in London, Paris, and Bombay; with Suggestions for obviating the Nuisance arising from the present defective state of the Board of Conservancy's arrangements for the purpose; together with Suggestions for the proper Regulation of the Bombay Burial Grounds.

APPENDIX I.

On the Amount of the existing Water Supply of Bombay, with reference to the Population; and on the various Methods which have been proposed for increasing the Supply, both from Sources within the Island and from Salsette.*

APPENDIX J.

On the System of Sewers already laid down for the Drainage of the Native Town; and on the improved System of Town Drainage recently introduced in England, and its applicability to Bombay.

APPENDIX K.

On the Practicability of Lighting Bombay with Gas.

66. In the notes appended to Appendices B, C, D, E, and F, I have given comparative statements regarding the executive expenditure of the Board of Conservancy, and that of the Road and Tank Department, and also regarding the municipal statistics of Bombay, as compared with those of certain English towns.

67. From these statements it appears, that as respects population, the average number of square yards of space to each person is in London 115·83, and in the six sub-divisions of the Native Town of Bombay, taken together, 9·56, and that our population is therefore nearly thirteen times as over-crowded as that of London; and that in London the mean annual value of rated property to each person is ten times as great as it is in Bombay.

68. The municipal revenue of Bombay is very much lower in proportion than that of any other town I am acquainted with where sanitary reforms have been attempted. There are towns in England (Plymouth for example) having a larger actual revenue, with only one-tenth of our population. I am about to write to England for official returns regarding the income and expenditure of the principal English towns, and I will communicate to the Board the information I receive on the subject; but the extreme inadequacy of our income to the wants of so large a population will appear evident from the figures given in the notes of my tables regarding certain

few out here have any knowledge of the practical details of such improvements, or have considered the advantage of adopting them as far as practicable in this island.

In this Report and its Appendices I have considered each of the principal subjects relating to the sanitary economy of a large town separately, and in treating of each of them, I have described—1*st*, the past and present condition of Bombay, with reference to the particular subject under consideration; 2*nd*, I have given the details of the most recent and improved arrangements adopted in English towns with reference to the same subject; and 3*rd*, I have pointed out in detail the extent to which the English plans might with advantage be adopted in Bombay.

* This has been already published in the "Selections from Government Records," No. I.

items in the municipal statistics of Liverpool and other English towns: Liverpool, for example, with a population of 369,000, contains 174 miles of made carriage way. Were our roads in the same ratio to our population, we should have 244·7 miles; we actually have only 130. The average cost of the repairs and maintenance of our 130 miles of road is Rs. 75,403-9-8 per annum. At the Liverpool rate of cost of repairs of macadamized roads per mile, it would be Rs. 8,29,439-10-4 (nearly eight lakhs and thirty thousand), and if we had the Liverpool proportion of roads to our population, this item would in Bombay be Rs. 17,81,856-10-8, or nearly eighteen lakhs per annum.*

* The rate I have given (a penny per yard per annum) as the average cost of the repair of the Bombay roads, includes also the cost of watering, whereas the London and Liverpool rates are exclusive of watering. In Dempsey's Rudimentary Treatise on the Drainage and Sewerage of Towns and Buildings, page 118, the cost of watering is stated as follows:—"It has been ascertained in London, that one ton of water, or 252 gallons, is sufficient to lay the dust over a surface of 600 square yards of gravel or macadamized roads, or of 400 square yards of granite paved streets. The average number of days per annum in which it is found, from 20 years' experience, to be necessary to apply water for this purpose, is about 120. The common charge for this work is at the rate of $\frac{3}{4}d.$ per square yard for the season, the water being applied only once per diem, or £50 per mile of a main road. The common assessment per house for watering roads twice a day is £1 for the season." The number of houses in London is between 280,000 and 300,000, but many of the back streets are seldom watered.

I have compiled the following table from the answers of the various Water Companies of London to the queries of the Board of Health on the subject:—

Water Companies.	Quantity of Water used daily in watering (morning and evening) each Mile of Street 30 feet wide.	*Ditto per Season of 120 Days.*	Cost of Watering one Mile per *Day.*	Ditto Season of 120 Days.
	Gallons.	Gallons.	Rupees.	Rupees.
New River Company	8,774	1,052,880	5	660
East London Water Company	10,476	1,257,120	6	750
Southwark and Vauxhall Water Company	No return.	....	From 4 to 5	From 500 to 600
West Middlesex Water Company	Ditto.	....	6	750
Lambeth Water Company.	16,000	1,920,000	3	366
Chelsea Water Company..	From 15,000 to 20,000	From 1,800,000 to 2,400,000	From 4 to 6	From 506 to 733
Grand Junction Water Company	14,000	1,680,000	6	733
HampsteadWaterCompany	8,000	1,036,800	5	600

Of the 130 miles of macadamized roads within this island, the larger proportion are never watered at all. None are watered on Sundays. 32 miles, 6 furlongs, and 139 yards are watered six times a week; 2 miles and 173 yards are watered four times a week; 18 miles, 5 furlongs, and 129 yards are watered three times a week; and 5 miles, 5 furlongs, and 146 yards are watered twice a week; making a total of 272 miles, 7 furlongs, and 5 yards of double watering effected during each working week of 6 days: this is equivalent to 45 miles, 3 furlongs, and 184 yards (about one-third of our total road mileage) of double watering effected daily.

I have shown that the London rate for road-watering is from Rs. 500 to 700 per mile per season of 120 days. The length of the Bombay season for road-watering is (exclusive of

69. The assumption that, on an average, each town inhabitant makes an equal amount of litter, would lead to the conclusion that the amount of scavengering required in different towns should be in direct ratio to their respective population; yet the scavengering of Liverpool, with a population of 369,000, and a street surface mostly paved, and non-absorbent, costs Rs. 1,00,021 per annum.* Were the cost of scavengering the town of Bombay in the same ratio to our population, it would be Rs. 1,40,679 per annum, whereas the actual average cost is only Rs. 34,870 per annum.

70. In Liverpool, with a population of 369,000, more than 17 miles of new sewerage were completed last year: were our sanitary improvements pushed on in the same ratio to our population, we should construct 24 miles of sewers per annum. Our actual rate of progress has been hitherto less than 2 miles per annum, on the average, and our maximum less than 3½ miles per annum.†

Sundays) 217 days: this would make the cost of watering a mile (at the London rate per day) from Rs. 904 to 1,265 per season of 217 days; and at these rates the cost of the small mileage of road-watering done at Bombay would be from Rs. 41,121 to Rs. 57,569. The actual cost is Rs. 33,248 per season. The cost at the London rate per day of watering the whole of our 130 miles of road twice daily for 217 days in the year would be from Rs. 1,17,541 to Rs. 1,64,558 per annum. The quantity of water required to keep the dust laid per each mile of road is of course greater in India than in England.

* Report to the Health Committee of the Borough of Liverpool by the Borough Engineer, Inspector of Nuisances, and Medical Officer of Health, Liverpool, 1851.

† The flow of liquid in the sewers for each individual of the population is extraordinarily small at Bombay.

The recent paving of the channel of the main town drain afforded an opportunity for experimenting on the quantity of liquid that flowed along it. A dam of clay had been fixed across the channel to keep the sewerage water from annoying the workmen employed on the lower portion; such dam being periodically removed, to allow of the escape of the sewerage that had accumulated behind it.

Immediately below this dam I had two brick tankees constructed side by side, the capacity of each being 448 gallons. A bifurcated dammered wooden gutter was laid from the level of the sewerage accumulated behind the dam to each of these tankees, arrangements being made for instantaneously diverting the flow of the sewerage from one tankee to the other at pleasure. A large leather hose communicated with the bottom of each tankee, its orifice being hooked up while the tankee was filling, and let down for the purpose of emptying it.

The sewerage water was allowed to run through the forked wooden channel into these tanks alternately: the instant the first was filled the current was diverted into the second, and long before the second was full the first was emptied, and ready for filling again.

By this apparatus, the quantity of liquid running through the drain was twice measured, each time for twenty-four hours continuously, and the experiment gave a result of under 9,000,000 gallons of sewerage per annum for a population of 220,000. This is only about one-fifth of the average proportion of sewerage to population in England, as given by Smith of Deanston, and other standard authorities, as the result of direct experiment in English towns.

One principal reason for so great a difference is that in England it rains almost daily, while at Bombay not a drop of rain falls during the eight months of the dry season. In England, moreover, the circumstance of the sewers being lined with cement prevents leakage; and even

71. The most correct idea of the deficiency of drains at Bombay will be conveyed by comparing the ratio of sewer mileage to population in Bombay, exclusive of the Fort and other towns.

72. London, with a population of 1,873,000, contains upwards of 700 miles of sewerage (see Weale's London, page 829); Bombay, inclusive of the Fort, contains a population of 442,031, and less than 14 miles of sewerage. It will be remembered that this is less than the amount (17 miles) constructed in a single year in the town of Liverpool, with a population of 369,000 only.

73. We could never hope in Bombay for so large a municipal income, in proportion to our population, as that of the Metropolis. The amount of the latter may, however, be stated here.

74. In London, street improvements, and those of a sanitary nature, are paid for from different sources, and executed by distinct departments, having no connection with each other. The sewerage of the Metropolis is maintained and extended by means of a sewerage rate, limited to 5 per cent. (or one shilling in the pound) on the rental; and in 1850, the actual assessed net rental of the district subject to the jurisdiction of the Metropolitan Commission of Sewers (from which jurisdiction the "city" is exempted) was £12,186,000. 5 per cent. on this would be nearly Rs. 61,00,000 a year, but 5 per cent. is the limit, and the amount of the *general sewerage rate* actually levied is always greatly within it. In addition to the general rate, the Commission is empowered, "according to its judgment," to provide for the cost of any particular improvement by a "special rate" on the properties immediately benefitted thereby, the amount and mode of levying which they fix without appeal. They are also empowered to levy "an improvement rate," which is fixed at a maximum of 10 per cent. on the rack rent, in respect of works they may judge to be of private benefit. If, with reference to the rate

were they not so lined, the fact of the drains being generally laid at a depth of from 12 to 20 feet below the surface of the street, and being therefore in contact with soil surcharged with moisture, and consequently non-absorbent, would in great measure prevent the escape of the sewerage.

In Bombay, on the other hand, the sewers are not water-tight, and are all laid close to the surface, in soil which, owing to the dryness of the climate, sucks up every drop of moisture within reach of it. Another reason of the scantiness of the sewerage is the scanty consumption of water, and the absence of house-drainage, whereby the household slops and waste water of the population could be conveyed to the sewers, instead of being, as at present, thrown out on the thirsty soil, and there absorbed or evaporated.

For the above reasons, it is evident that the contents of the Bombay sewers must contain a much larger proportion of solid matter than is the case in England. Had the sewers of Bombay been originally constructed of a section proportionate to the actual amount of sewerage water flowing through them, the nuisance now occasioned by the annual removal of the large amount of sediment which collects in their channel would have been avoided.—(See Appendix J, on the drainage of Bombay.)

of assessment at Bombay, it be remarked that, in London, 5 per cent. was the *limit*, and that the rate *actually levied* was always considerably within that limit, it must at the same time be remembered, that the mean annual rental per head is in London ten times as high as it is in Bombay; that landlords at Bombay have no other rate at all to pay out of their rental, but that proprietors in London have to pay in addition heavy police-rates and poor-rates, the latter alone amounting on an average to an additional 8 per cent. per annum on the rental.*

75. Street improvements in London are, for the most part, paid for by a duty of 13*d.* per ton, on the 3,000,000 tons of coal annually brought within 20 miles of London. This yields an income of Rs. 16,25,000 per annum; and from the annexed extract from a paragraph on the subject, which has recently gone the round of the London papers, and been extracted in the *Home News*, &c., it appears that, of the nearly four crores last raised from these duties, by far the greater proportion was spent in improvements within the city district of the Metropolis, a district containing a population of only 129,729.

76. "*Coal Duties.*—Of the £3,738, 067 raised by duties on all coal brought within 20 miles of London, the whole has been spent on improvements executed within a mile and a half of the General Post Office, excepting only the New Victoria Street, just laid down, and about to be built from Westminster Abbey to Pimlico. With this solitary exception, every farthing of duty paid upon the coal burnt in all Middlesex, and in a great part of Essex, Surrey, and Kent, has been spent in a small circle of a mile and a half radius. But the greater part of the sum has been spent within much narrower limits; that is, on the city and its immediate approaches. In the report, the amounts assigned to the three heads abovementioned are, £1,117,345 within the city, £807,500 without the city, and £1,813,221 of a general character; but the city has had the lion's share in the last expenditure, not only in having the actual disposal of the money, but in being itself the locality of the improvements."

77. The defective state of our municipal regulations prevents the amount annually spent in Bombay on sanitary improvement from going as far as it otherwise would. The expense of draining a street is two-fold—there is the large sewer along the centre of the street, and the small cross-drains at an average distance of 20 feet from each

* By the new Act at Calcutta, the assessment is limited to 6½ per cent. on the *gross* annual rental, and the Calcutta Bench have lately fixed the amount to be levied at 6¼ per cent. In Bombay the rate is levied on the net instead of on the gross rental (10 per cent. being first deducted from the latter on account of repairs). A rate of 6¼ per cent., levied on the Calcutta system, would therefore amount to within ane anna of a rate of Rs. 7 per cent. levied according to our system.

other, to the houses on each side. In English towns the former only is made at the expense of the municipality, and all houses within 50 feet on each side of it are not only *compelled* to have cross-drains immediately constructed to join it, at their *own expense*, but are obliged also to pay a fee, amounting in London to Rs. 32, on doing so.

78. The principle of dividing the charge of works of sanitary improvement over a series of years, and raising the money immediately required by loan on the security of the rates, has been of late much advocated, and extensively adopted in England ; and the adoption of the same principle in Bombay would, in my opinion, be attended with great advantage.

79. The following extracts on the subject are from the report of the Committee of Health of Towns Association, and on Lord Lincoln's bill for sewerage, drainage, &c. of towns, page 27 :—

" 44. *Sanitary improvements, to be effectual, must be carried out on a vast scale. There is scarcely a city or town in the kingdom which does not need extensive works, to place either its drainage, its sewerage, or its supply of water, in a satisfactory condition ; and in the great majority, it is necessary that such works should be commenced almost entirely anew. But the difficulty of enforcing, by legislation, the general adoption and completion of works of such magnitude, is the expense which they must necessarily involve.* Had the recent inquiries done nothing to show how this expenditure can be met, but little progress would have been made towards the practical introduction of remedial measures. These inquiries, however, do point out in the clearest manner—1*st*, how the required capital can be raised ; 2*nd*, how it can be repaid ; and 3*rd*, how the repayment can be so distributed as not to be felt as a burthen by the persons who ought, in justice, to defray the expense. These three things having been shown, all real difficulties on the part of the legislature, in enforcing the universal adoption of primary essential sanitary improvement, may be said to be at an end.

" 45. The plan proposed is, that whatever capital is required should be raised by a loan, or by persons contracting for the execution of the work, on the security of a special rate, to be levied on the property in the several localities, the principal and interest to be repaid by annual instalments within a limited number of years. On this plan, no immediate outlay is necessary ; the burthen is distributed over a series of years, and, being commuted into an annual rent charge, is not practically felt, even by the poorest tenant.

" 46. Her Majesty's Commissioners, fully appreciating the importance and the efficiency of this principle, say, in their First Report (Vol. I. page 23) :—'The evidence recited generally recognises that principle of legislation to be just and acceptable, which has been suggested

for lightening the burthens of future improvements, by spreading the expense of the outlay over an extended period, so that the cost might be repaid within a reasonable time with interest, by an annual rate, or by an addition to the rent, unless when the persons interested choose to perform the work themselves, under proper regulations, or where they prefer liquidating the charge at once.'

"47. The tenth recommendation of Her Majesty's Commissioners, contained in their Second Report (Vol. I. page 51), is in the following words:—'We therefore recommend that the expense remain a charge upon the properties, to be levied by a special rate upon the occupiers, and recovered with interest by annual instalments within a certain number of years, unless the owners prefer to pay the cost in the first instance.'

"48. A mode of procedure, in accordance with this recommendation, is pointed out in a suggested form of notification (First Report, Vol. II. pages 295, 296), and evidence is adduced to show, from the testimony of men of the highest authority, that the adoption of this principle would at once remove all material difficulty, and give general satisfaction. Thus, it is stated by one of Her Majesty's Commissioners (Dr. Playfair) that the 'distribution of charges for improvement under a competent authority, a system unanimously recognized by eminent practical men, such as those whose evidence I have already brought forward, would obviate all those evils. The charges should be distributed over a term of years co-equal with the probable duration of the improvement.'

"49. In like manner, another of Her Majesty's Commissioners (Mr. Smith of Deanston) states in his report (Vol. II. page 164), that 'the adoption of the principle of dividing the charges over a series of years, and raising the money immediately required by loan on security of the rates, will greatly diminish (he might have said, may be made entirely to remove) the immediate pressure, and so far remove the hostility of the rate-payers to necessary and efficient works of improvement. Besides, substantial justice will be done to life-renters, many of whom have no other source of living, but by a limited amount of rent drawn from house property. Nevertheless, I believe that this jealousy might be abated, by a properly adjusted and revised system of contract management, which would be cheaper than any other.'

"50. Mr. Roe says (First Report, Vol. II. page 169):—'On the principle proposed for the distribution of the charge as a rent over a period, coincident with the benefit, nearly the whole inconvenience, and all injustice to owners of short interests in the immediate outlay, is got rid of. This principle of the distribution of the charge is essential to all plans. It is only justice: the improvement is permanent, and it is manifestly unjust that the whole cost of it should fall on the present owner.'

"51. The evidence, with equal clearness, shows that the cost ought to be charged on the occupier, not the owner. The owner is often merely a lessee, having only a short term of his lease unexpired. No cottage owner has funds at his disposal for any costly improvement: he has very rarely the fee simple, or even an unencumbered life interest in the property. The ownership is frequently so complex that there is the utmost difficulty in discovering it. A man, for example, gives his property to his married daughters, to be equally divided amongst their children. In a case like this, the respective shares in such property could only be ascertained, perhaps, after an expensive chancery suit; while to charge the lessee, or the person in receipt of the rents, who may be within two or three years of the expiration of his lease, with the cost of improvement, not unfrequently amounting to more than the annual rental, would be to confiscate his property. The true remedy for all these evils is not only to distribute the cost over a period commensurate with the benefits, but to fix the charge on the person enjoying the benefit, that is on the occupier, not the owner. 'The only exception,' says Dr. Playfair, 'is the case of monthly or weekly occupiers, when, to prevent the expense of frequent collections, such charge might be made on the owner, who is now to be looked upon in the light of a collector of rents, and, if required, to receive a per-centage for the additional trouble.' "

80. The following table exhibits the comparative executive expenditure and charge for executive superintendence of the Board of Conservancy and the Road and Tank Department for the last six years, for which the accounts have in each case been made up:—

Departments.	Expenditure in the last six Years of which Accounts are made up.	Average per Annum.	Charge of Executive Superintendence during same period.	Average per Annum.	Per Cent. of Superintendence on Expenditure.
	Rupees.	Rupees.	Rupees.	Rupees.	Rupees.
Board of Conservancy	12,79,245	2,13,207	83,633	13,939	6½
Road and Tank Department.	13,55,448	2,25,908	3,87,917	64,658	28½*

* The extraordinary high cost of the engineering superintendence of public works executed by the Indian Government has lately been much commented on in England, and in some cases greatly exaggerated—take for example the following extract from a letter on the subject that has lately appeared in the *Manchester Times* and *Examiner* :—

"Sir,—Mr. Ewart has obtained a return of the amount of money expended on public works in India for the ten years ending 1845-46, which return shows an expenditure of £399,276 for the Bombay Presidency, in works of irrigation, roads, and bridges. I know of no work of irrigation in the Bombay Presidency, nor can I learn that any such exists, constructed at the cost of Government. As for roads and bridges, one-fifth part of the sum named would

81. From this table it appears that the executive expenditure of the Superintendent of Repairs' Department, for new works and repairs, has

pay for all there are, whether constructed in ten or two hundred years. This account, then, if not altogether an invention, would, if analysed, show one-fifth of the amount expended on works, and four-fifths in salaries. Nor is this to be wondered at, if we consider that the members of the Government are interested in salaries only; in commercial prosperity not at all. The greatest public work undertaken by the Indian Government, beyond all comparison, is that of the Doab canal, in the north-west of Bengal, a work intended both for irrigation and navigation. It is estimated to cost a million and a half sterling, and for which purpose £50,000 a year has been voted. *As a means of navigation, it will produce no return till completed, and at the rate of £50,000 a year, it will take thirty years to complete it, thus involving a loss of one million sterling by interest on unproductive capital, to say nothing of waiting thirty years for the advantages which it promises.* In the hands of private enterprise, the work would be completed in two years. The other principal works of irrigation in India, those of the Madras Presidency, have occupied a still greater length of time in their construction. Operations were commenced on the Cauvery in 1809. In the course of forty-five years Rs. 30,00,000 (£390,000) were expended on it, or at the rate of £8,600 per annum; the revenue (land revenue) having increased in this space of time from Rs. 31,00,000 to Rs. 49,00,000, the gain being close upon Rs. 18,00,000 per annum, the money invested being returned in about two years. The gain on the Godavery operations, with an outlay of Rs. 13,00,000, amounts to Rs. 18,00,000 per annum.

"The moral of these facts is, that public works in the hands of Government are regarded principally as a means of extending patronage, by maintaining an army of superintending officials; and next, that the advantages accruing from such works are devoted to the same end by means of increased land revenue."—*Times and Examiner, Sept. 8.*

The *Bombay Gazette* of the 30th September 1850 contains an elaborate abstract of the annual reports (printed by authority) of the Bombay Road and Tank Department for the nine years ending 30th April 1850, showing the total cost of superintending the public works executed by that department during such period to have averaged 48 per cent., and to have amounted in some cases to upwards 300 per cent.! The following is an extract from the abstract furnished by the *Gazette*:—

"We have now before us a complete set of reports of the Road and Tank Department for the nine years ending 30th April 1850. From these we learn, that within this period Government has expended through that department, in the construction of roads and brides, buildings and tanks, wells and bunds, the sum of Rs. 20,13,098, or an average of Rs. 2,23,677 per annum; and that to superintend these works the Superintendent of Roads, his Assistants, and his 'Subordinate Superintendents' have drawn upon the revenues, in addition, at the rate of fully 48 per cent. upon the outlay—the Superintendent's share of the cost of superintendence being 11·7 per cent.; the share of his Assistants, 13·3 per cent.; and that of his 'Subordinate Superintendents' being 5 per cent.;—the maximum cost of the Superintendent's labour being 13·6 per cent., the minimum 9·5 per cent., and the average 11·7 per cent.; for all his Assistants, the maximum being 50 per cent., the minimum 18·62 per cent., and the average 31·3 per cent. For the labour of Subordinate Superintendents the cost is fixed at the rate of 5 per cent. upon the outlay. Taking the cost of the superintendence of individual Assistants, we find the range to be from 1¼ per cent. to 326 per cent.!

* * * * * * *

"We now proceed to give the cost per cent. of engineering and superintendence, in proportion to outlay. To economise space, we substitute for the heading 'Superintendent of Roads and his Office,' the numeral letter I.; for the 'Assistants,' the numeral II.; for the 'Subordinate Superintendents,' the numeral III., for the 'Total,' the numeral IV.; and for the 'Range of Cost on account of the Superintendence of Assistants,' the numeral V. *We beg to explain,*

been, on the average of the last six years, Rs. 2,13,000 per annum, or very nearly equal to that of the whole Road and Tank Department, which

that after the year 1845-46 *the Superintendent of Roads discontinued giving the cost of his own work*, and we have, therefore, no help for it but to take that for the five years ending 30th April 1850 at the five years, which is, of course, in such case, the average of the whole nine years. With these remarks, we now beg to subjoin our statement:—

	I.	II.	III.	IV.	V.
1841–42....	9·5	35·50	5	50·00	77 to 13
1842–43....	13·6	50·00	5	68·60	326 to 15
1843–44....	13·3	42·95	5	61·25	69 to 15
1844–45....	10·4	46·60	5	62·00	66 to 30
1845–46....	11·7	26·75	5	43·45	52 to 1·5
1846–47....	11·7	18·62	5	35·32	56 to 1·2
1847–48....	11·7	21·33	5	38·03	66 to 3
1848–49....	11·7	21·71	5	37·41	65 to 7
1849–50....	11·7	19·25	5	35·95	255 to 8
Total....	105·3	281·71	45	432·01	
Average....	11·7	31·30	5	48·00."	—*Gazette, Sept.* 30.

It is true that this 48 per cent. does not represent the total cost to Government of the existing system of superintendence in the Road and Tank Department, inasmuch as in most cases only a portion of the allowances received by the officers therein employed is charged to the works they superintend, nor does it include the cost to Government of the pensions incidental to the present system; but making allowance for these charges, the cost to Government of the present system of superintendence would probably not be found to exceed 100 per cent. It is true that this per-centage would be about forty-five times as much as the Belgium Government has had to pay for the engineering superintendence of the system of railway communication it has constructed throughout its territories; but, on the other hand, it is very greatly less than what the writer in the *Times* asserts, viz. that out of the total cost of public works to the Indian Government four-fifths is expended in salaries.

The return (obtained by Mr. Ewart) wherein the last ten years' expenditure on public works within the Bombay Presidency was stated at about Rs. 40,00,000 may possibly have included repairs as well as new works. The amount is certainly much larger than any one personally acquainted with the deficiencies of the Western Presidency in respect to internal communications would have been prepared to expect.

The *Gazette* of the 7th October contains tables (compiled from the same official data), showing the cost of the personal superintendence of each individual officer of the Road and Tank Department in each year: the lowest rate is that of Mr. Sub-Assistant Conductor Armistead, whose superintendence has averaged 5¼ per cent. only on the outlay of the works he has executed during five years' employment; the two highest rates are those of Lieutenants Kemball and Trevor, whose superintendence had *averaged* 201 and 255 per cent. respectively.

The Bombay Engineers' Report for the official year 1850-51 states the last year's expenditure of the twenty-one engineering establishments included in the return at Rs. 8,65,060-9-3, and the cost of superintendence during the same period at Rs. 2,21,241-13-4, or 25½ per cent.; but this does not include the cost of the Superintending Engineers and their establishments, nor, in most cases, I believe, the "usual 5 per cent. for subordinate superintendence." These statements, however, convey a very inadequate idea of the total cost to the Indian Government of the system under which their public works are executed; for it is the practice, in many cases, to charge only a portion of an engineer's total allowances to the work he superintends, although he may be charged with no other duties than the superintendence

during that period has averaged Rs. 2,25,000 per annum only. It also appears that the cost of superintending the executive expenditure of the

of such particular work. For example, in last year's Bombay Engineers' Report, the cost of the Dockyard Engineer's superintendence is stated at only Rs. 600 per mensem, although his cost to Government during the period had been upwards of Rs. 1,000 per month. The same remark applies to the statements published by the Road and Tank Department. In comparing the cost of the system under which the public works of the Indian Government are constructed with that adopted by European Governments (that of Belgium for example), the expense of the pensions incidental to the former must be also considered.

The system of railway communication by which Belgium is traversed was constructed, not by private enterprise, but directly by the Government of the country. The sections opened to traffic up to the 1st of January 1842 had cost £3,023,769, 18*s.* 6½*d.*, and the total of "salaries had been only £69,749 12*s.* 9½*d.*, or 2¼ per cent. only on the outlay." Even adding to this the expense of printing, instruments, furniture, and "unforeseen and extra expenses," the *total charges* on the outlay (exclusive of law expenses, which amounted to ¼ per cent. only) was under £81,000, or 2¾ per cent.

The annual cost of superintendence, &c. for about 70 miles of Belgium railway was as follows:—

One *Ingénieur en Chef Directeur*		£ 600
Two *Ingénieurs Ordinaires,*	at £320 each	640
Six *Conducteurs,*	at £200 each	1,200
Twenty *Surveillants,*	at £100 each	2,000
Office expenses, printing, &c.		680
	Annual total	£5,120

The average time required for the completion of a line of this length being about two years, the expense of superintendence may be taken in round numbers at about £150 per mile. A late Colonel Commandant of the Bombay Engineers has recently (under the signature of "An Old Indian") addressed a series of letters to the *London Times,* in which many examples are adduced of the terribly slow progress of public improvement in the Western Presidency under the present system. The difficulty experienced by a subordinate Government in obtaining sanction for the expenditure of any but a very limited amount on any one single work in one year causes the very limited total annually available for internal improvements to be frittered away in fifty different dribblets, each requiring a separate and distinct superintending establishment, instead of being concentrated, for the purpose of finishing out of hand some one important work. The great cost of superintendence is not the principal evil of such a system, for few works can be productive until completed; and the loss of interest at present accruing during the tardy progress of a single work would, in many cases, be sufficient for the construction of two such works under better arrangements.

From the Bombay Engineers' Report for the official year 1850-51 it would appear, that the annual expenditure of the various engineering establishments is generally greatly less than such establishments are capable of superintending. Thus, in the southern military division there are 10 officers and establishments employed, yet one of them (at Sattara) appears to superintend, at a cost of only 11 per cent., an annual expenditure (Rs. 2,28,425) about equal to that of the whole of the remaining nine put together; the cost of the superintendence of these latter averaging 32½ per cent., or about three times as much as that of the Engineer at Sattara. It will also appear, that commissioned officers are often employed on petty works which in England would be considered far too simple and inexpensive in character to require scientific superintendence at all; and in cases where scientific superintendence is really essential, it would often appear to be of a more costly description than necessary. For instance, in page 75 of the last Bombay Engineers' Report, the two first officers in the list of the Road and Tank Department are respectively a Captain and a Sub-Assistant Conductor. Both

Board of Conservancy has been less than a quarter of the charge for superintendence in the Road and Tank Department.

82. The European establishment of the Road and Tank Department consists of 1 Superintendent, 2 First Assistants, and 7 Second Assistants (in all ten officers of the line or Engineers), assisted by 8 trained European Overseers, mostly non-commissioned officers of the Sappers and Miners. I believe there is no Second Assistant in the Road and Tank Department in charge of a single extensive work, who has not one or more trained European subordinates on his establishment. The Superintendent of Repairs, though in charge of works equal in amount to those of the whole Road and Tank Department, has no European executive subordinate whatever, and I think it is essential to the due superintendence of the works under his charge that this deficiency should be remedied.

83. It must be remembered, moreover, that the officers of the Road and Tank Department have no other duties to attend to than those of an executive engineer; but that the Superintendent of Repairs, in addition to the control of an executive expenditure exceeding Rs. 2,00,000 per annum, and involving the superintendence of works often exceeding 20 in number, and scattered over 130 miles of road, has also to perform the equally onerous functions of Surveyor to the Court of Petty Sessions, and to listen daily to the representations of every one (out of a population of half a million) who wants to build or repair a house, or thinks himself aggrieved by any summons or notice issued from either of the two departments.

84. It may be objected to the above comparative statement, that the works executed under my superintendence are all in the same neighbourhood, while those of the Road and Tank Department are scattered over a large extent of country; and that the cost of superintendence would be naturally greater in the latter case. I will therefore cite a a case more directly in point. The annual executive expenditure of the Executive Engineer at Poona is only from Rs. 60,000 to Rs. 90,000 per annum, yet he has three Europeans on his executive establishment. I believe he has no other duties than those of an Executive Engineer to attend to, and his works are confined to a cantonment only containing a length of, I should think, nor more than 15 miles of road. The

seem to be employed on precisely the same description of work. The annual expenditure, and the amount of the estimates sent in by the Sub-Assistant Conductor, rather exceed those of the Captain, but the cost of the superintendence of the latter is stated at nearly double that of the Sub-Assistant Conductor. And it is really very much more than double, inasmuch as the total cost to Government of a Captain employed as a First Assistant in the Road and Tank Department is about Rs. 738 per mensem, of which only Rs. 325, or less than half, is charged to the works which it is his sole employment to superintend.

executive expenditure of my office has during the last six years averaged more than double this, viz. Rs. 2,13,207-9-6, and is increasing, and the works are scattered over 130 miles of road: yet, at present, I have no European subordinate in the executive branch of my office.* The cost of superintendence in the Executive Engineer's at Poona is stated by Major Turner (page 13 of the Bombay Engineers' Report for 1850-51) to have been, during the past year, 29⅝ per cent. on the expenditure, or rather more than the corresponding charge in the Road and Tank Department.

85. The rates given in Appendix F, at which the works of the Conservancy Department have been estimated and executed, are lower than those of any other executive department in Bombay.†

The office rates of the Superintendent of Repairs' Department were, at my suggestion, forwarded by the Board of Conservancy to the Military Board in December last, for comparison with those of other executive departments at Bombay, and by the minutes of the Garrison Engineer and Civil Architect on them, forwarded with the Secretary to the Military Board's letter No. 826 of 1852, it appeared that the rates of the two principal descriptions of works, in the Superintendent of Repairs' Department (masonry and road metalling), were in each case 20 per cent.

* The business of my office has of late years greatly increased, without any increase having taken place in the strength of the establishment. The number of periodical returns, together with those required by new standing orders, has been more than trebled during the last two years. The number of pages of correspondence despatched from my office during the ten months that have elapsed of the present year are more than double the average of the corresponding ten months of the three years preceding my taking charge of the office, and the increase in the number of pages of estimates forwarded is in the ratio of 17 to 11. When the Board was first established in 1845,—the municipal revenue for the three preceding years having been, for 1842-43, Rs. 2,17,980-5-5; 1843-44, Rs. 2,21,064-13-4; 1844-45, Rs. 2,24,860-15-5, or on the average of these three years Rs. 2,21,302,—the establishment of the Superintendent of Repairs was fixed at Rs. 2,089 per mensem; and the necessity of considerably increasing such establishment appears to have been contemplated by the wording of Clause 13 of Act No. XI. of 1845, wherein the Bench were authorised (subject to the approval of Government) "to appoint one *or more* Superintendents of Repairs." The municipal income during the last three years has been, for 1849-50, Rs. 3,80,677-13-10; 1850-51, Rs. 3,49,149-0-9; 1851-52, Rs. 3,96,042-14-1, or on the average of three last years Rs. 3,75,290, or 41 per cent. more than the average of the three years immediately preceding the appointment of the Board; yet during this period my establishment has been increased from Rs. 2,089 to Rs. 2,229 monthly, or 6¼ per cent. only, and even this does not represent an increase in the number of individuals employed so much as increase of pay on account of long service to some of the Natives employed by the department. At present, my establishment is so weak handed, that by temporarily attending to any single branch of the duties of the office in the manner that in my opinion every branch ought always to be attended to, other duties must of necessity be unduly neglected.

† There are generally about 20 new works in hand at a time; the greatest number last season was 37: the largest number of workmen employed daily by this department has been about 4,000; at present the number is under 2,000.

lower than the corresponding ones of the Garrison Engineer and Civil Architect's office.

86. I attribute the fact of the contracts letting so low in the Superintendent of Repairs' office solely to the circumstance of their being disposed of by verbal tender in public auction, instead of by written tender, as is generally the case in other departments. It is evident that by the latter method the benefit of the principle of completion cannot possibly be so fully realized as it is by the former.

87. The rate (1*d.* per square yard per annum) of the road-repairing contract* I consider less than the work can be properly done for. My predecessors were also of opinion that the rate at which the repairing and scavenging contracts was let by the Bench was too low; emulation, and the temptation afforded by the large monthly payments to be made on account of the contract (which is for three years) often inducing Native contractors to tender at a rate at which they can only make a profit by evading the proper performance of the work, and the small numerical strength, and low pay and condition of the Native subordinates of the supervising establishment facilitates their doing so.

88. In last year's Report of the Health Committee to the Borough of Liverpool, it is said with reference to contracts:—"The course adopted is to select the parties who tender for the work; and this has been found to be attended with the best results, as the Committee have the guarantee of character for the proper fulfilment of the contract, a security being, in the estimation of the Borough Engineer, and in our opinion, far better than the guarantee of a bondman."

89. I fear there would be great difficulty in selecting trustworthy contractors in this country: in the course of my experience in India I have not succeeded in discovering any of the sort.

90. The Supervising Board, corresponding in English town with the Board of Conservancy at Bombay, is sometimes composed of *ex officio* members, and sometimes of stipendiary and elective. The old elective commissioners system has in England been found productive of much jobbery and useless expenditure (the first regarding house property affected by public improvements, and the last through the assumption of executive functions by supervising boards); the system would be much more liable to such abuses in India. Since the recognition of the vital importance of the sanitary question in England, it has been felt that the maintenance of the public health is a function of Government, too important to be altogether delegated to irresponsible and fluctuating local boards, and the tendency of subsequent legislation appears to be

* The roads are made and repaired with basalt, a material excellent for heavy traffic, but far too hard to admit of being reduced to a surface as smooth as that of a limestone road.

to define the exact functions and powers of such boards very strictly, and to subject them to a central controlling authority.

91. The pecuniary loss arising from the mistakes of local boards is very considerable. In London it is calculated that nearly Rs.1,00,00,000 has been uselessly expended in making drains at wrong levels. Through the want of contoured surveys of the town, our town surveys are more defective in this respect than those of London could ever have been. The Native Surveyors of Bombay are untrained in the use of the spirit-level, and their mason's plumb-line level is altogether unsusceptible of the degree of accuracy required in taking sections of considerable length: it may therefore be presumed that there must have been a very considerable loss on this head at Bombay as well as in London.

92. There has also been a loss both of money and efficiency from the faulty flat-sided section of drains hitherto adopted: the egg-sloped sewer has now quite superseded the flat-sided forms in England, and I hope to introduce it at Bombay in all future works of this class. It is calculated (First Report, Vol. II. p. 462) that had the sewers executed during the last ten years in London been constructed on the egg-sloped instead of on the upright-sided section, a saving of nearly Rs. 25,00,000 would have been effected.

93. On comparing the published annual reports of the Board of Conservancy with those of similar boards in England, it will be seen that a correct census is essential to the completeness of such documents. I believe that (were a system suited to local circumstances adopted) no insuperable difficulty would be found to exist to the obtainment of an accurate census of Bombay, and I hope shortly to forward to the Board a report on the subject. No accurate census or mortality returns yet exist for any town population within the tropics, and the vital statistics of Bombay would therefore have a peculiar interest. It would be interesting to ascertain the effect of the extraordinary density of our town population on the mortality returns. I suspect it would be greatly neutralized by the open-air habits of the population, and the absence of glass windows or other checks to ventilation in their dwellings. It is also probable that the chances of infant life would be found to be much greater in our climate than in England.

94. Appendix G contains a rough estimate of certain public improvements which, for the reasons I have before given, I think are urgently and immediately required. They form a portion of the list and rough estimate for completing the drainage of undrained *made* streets within the town limits, forwarded to the Board by my predecessor, Captain Cruickshank, with his letter No. 338 of 1845.

95. This rough estimate, which only included roads within the town limits, and already made, amounted to Rs. 10,00,000. Captain Cruick-

shank framed no estimate for the expense of constructing and sewering the unmade roads within the town limits, or for main drains, or for the drainage of all portions of the island beyond the town limits, but he guessed them at about the same amount, and thought, that after providing for *their* just annual claims on the municipal expenditure, it would still be possible to get through his estimate for the drainage of the *made* streets within *the town limits* at the rate of Rs. 50,000 per year, and that, *at that* rate of progress, the drainage of the island might be completed in twenty years. It has not, however, been *found* possible to expend more than Rs. 20,000 per annum, in getting through the improvements estimated for in Captain Cruickshank's list; and the period he assigned for the completion of the drainage of the island must therefore be extended, perhaps not quite; in the ratio of 5 to 2, yet still very considerably.

96. The list of streets undrained, though already made within the town limits, conveys a very inadequate idea of the total drainage requirements of the Native Town. About one-third of the Native Town is comprised of what once *were*, and what are still *called*, "oarts." Forty years ago there were cocoanut plantations bounded by the principal bazar roads; when the town increased, their street-frontage was allowed to be often wholly occupied by houses, without any provision being made for proper roads in the interior; and the deficiency still exists, though these oarts have now become as densely populated as the original and regularly laid out portion of the Native Town. The houses within the oarts are clustered together at random, and in all sorts of ways, without any regular space being left between them for approaches, and with a total absence of all attempt at arrangement or uniformity, such as could not occur in any other country.

97. I have deemed that I could not satisfactorily answer a question relating to the proportion our municipal revenue bears to the urgent and immediate sanitary demands upon it, without laying before the Bench, as in the foregoing report I have endeavoured to do, as practical and intelligible a statement as was possible, of the present actual sanitary condition of our population, and of the little that had been done, and of the very much which still remains to do, towards improving it. I think that the data I have advanced warrant the conclusion that a very large proportion, probably nearly one-half of the deaths, from 12,000 to 16,000 in number, that annually occur in this island, are preventable, and due to causes which it comes within the province of Government and of the municipality to remove; *and also that the pecuniary means appropriated by Government to this object, and administered by the Board, are altogether incommensurate with the numbers of our population, and with the vast amount of preventable disease and death constantly taking place among us.*

98. The apathy that exists in Bombay, and that long existed in England, regarding the waste of human life, consequent on defective sanitary arrangements, is much to be deprecated. "When a ship has sunk," says a recent writer on the subject, "or a building has fallen, there is an immediate cry for the punishment of some invidual whose selfishness or carelessness has led to the calamity, in order that all men be warned against the like dereliction of duty in time to come; yet how few remember, that besides these occasional droppings, which so startle the ear, there is a great stream of death and misery holding its onwards course, as to which they have never asked the question, whether or not the bulk of its dark waters may be lessened."

99. "It is clear, therefore" (says the Report of the Health of Towns Association, on Lord Lincoln's Sewerage and Drainage of Towns Bill), "that though we remain inactive, disease and death do not. For the last eight years, the startling fact has been proclaimed, and has been constantly urged on the attention of the public and legislature, that every day's delay in the adoption of efficient sanitary measures cost the lives of 136 persons in England alone. * * * Why must this waste of life go on unrestrained, without even any attempt to check it?"

100. I have shown that Dr. Simpson, the Medical Officer of Health to the City of London, declares emphatically in his reports, year after year, that unless the promises of science be not an empty delusion, it is practicable to reduce human mortality within the town to the half of its present average prevalence.

101. Though Dr. Simpson's authority is a high one, and his opinion supported by authentic English data, and its correctness is apparently borne out at Bombay by the low rate of mortality of our only drained town district (the Fort), as compared with that of the island generally, it is of course possible that he may overrate the amount of human disease and death that can be prevented by improved sanitary arrangements, in stating it so high as 50 per cent. on the total mortality. But the *exact specific* per-centage by which the mortality might be reduced is not the immediate question: say it was not 50, but only 30 per cent., or even not more than 20 per cent.; still, at even the lowest of these rates, the mortality of Bombay would be reducible by about 3,000 deaths a year, and surely this would be a saving of human life well worth any efforts that could be made by a Government or municipality.

I have the honour to be, &c.

H. CONYBEARE,
Superintendent of Repairs.

Bombay, Superintendent of Repairs' Office, 31st March 1852.

APPENDICES.

APPEN

Details of the Income of the Board of Conservancy from all Sources, for Year's Total Expenditure, and the State of the Board's

Items.	For 10 Months and 21 Days of 1845-46.	1846-47.	1847-48.	1848-49.
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
House Assessment	94,929 14 1	1,32,904 3 10	1,44,878 3 11	1,52,081 3 6
Assessment on Government Buildings	.....	.....	.....	12,021 8 0
Market Fees	3,228 9 6	29,627 9 5	33,248 11 2	65,573 12 2
Wheel Tax	45,105 6 8	49,872 11 7	41,648 10 5	38,948 9 0
Fees on Sale of Liquor Licenses	453 0 0	48,292 3 11	21,592 4 5	21,516 14 8
Fees, &c. levied by the Court of Requests	5,422 0 0	7,446 0 0	7,743 0 0	8,221 0 0
Ditto ditto by the Collector of Land Revenue	386 3 4	2,487 14 0	4,325 14 0	3,454 5 9
Penalties levied by the Assistant Collector of Land Revenue	510 0 0	617 8 0	649 0 0	611 0 0
Fines levied by the Court of Petty Sessions	5,760 9 3	5,610 0 0	4,997 0 0	3,010 9 8
Ditto ditto by the Magistrate.	9,119 13 8	23,642 14 6	16,266 9 3	17,846 15 6
Private Contributions, and Sundries	22,520 9 6	3,528 8 0	898 1 6	10,870 0 0
Total Income of the Year	1,87,416 2 0	3,04,729 9 3	2,76,677 6 8	3,34,155 14 3
Cr. or Dr. Balance of last Year.	+1,00,444 13 2	+8,724 3 11	—5,676 3 6	—37,800 12 0
Total available Funds	2,87,860 15 2	3,13,453 13 2	2,71,001 3 2	2,96,355 2 3
Deduct Year's Expenditure	2,79,136 11 3	3,19,130 0 8	3,08,801 15 2	3,13,544 1 1
Cr. or Dr. Balance in Account with Government	+8,724 3 11	—5,676 3 6	37,800 12 0	—17,188 14 9

REMARKS.—From this table it will be seen the Board's total income for 1850-51 was Rs. 41,533 less than that of the previous year, and that Rs. 29,000 of this deficiency was due to a falling off in the wheel tax. This falling off having been occasioned by temporary causes, and the accumulation of arrears, the tax ought more than to recover itself this year.

By the abolition of the Court of Requests, Government has deprived the Board of an item of revenue hitherto averaging Rs. 6,852 per annum.

The alteration lately made in the collection of the municipal taxes will have the apparent effect of increasing the Board's revenue by Rs. 25,802, before it really increases at all. Previous to the appointment by the Board of a Collector of Municipal Taxes, the income arising from such taxes was entered in the credit side of the accounts, less the cost of collection, which in 1849-50 amounted to Rs. 25,852. Now the gross produce of these taxes is carried to the credit of the Board, and the cost of collection charged to expenditure.

I have compiled this table from the published accounts of the Board, making corrections in two instances

DIX A.

each Year, from 1845-46 to 1852-53, both inclusive; showing also each Account with Government at the close of each Year.

1849-50.	1850-51.	1851-52.	1852-53.	Total for 8 Years.	Yearly Average.
Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1,57,720 5 5	1,63,064 8 5	1,65,119 6 8	1,71,872 12 0	11,82,570 9 10	1,47,821 5 2
12,899 0 0	12,904 0 0	25,798 0 0	.....	63,622 *8 0	12,724 8 0
66,115 14 4	62,311 9 6	59,093 8 0	60,317 2 4	3,81,716 12 3	47,714 9 6
79,158 10 6	56,965 9 0	83,443 7 3	79,092 13 0	4,73,338 13 5	59,167 5 8
32,498 8 7	25,500 5 2	9,561 3 7	34,569 12 3	1,94,664 4 7	24,333 0 6
6,000 0 0	6,281 0 0	5,895 0 0	.....	47,008 0 0	6,715 6 10
2,233 13 0	2,826 2 0	3,500 2 4	3,924 12 0	23,139 2 3	2,892 6 3
486 0 0	370 0 0	250 0 0	510 0 0	4,003 10 0	500 7 0
3,028 4 0	2,666 2 8	2,292 15 9	5,568 0 8	32,933 10 0	4,116 11 3
13,946 15 0	15,816 4 0	18,042 10 5	17,932 7 3	1,33,114 9 7	16,639 5 2
4,530 7 0	1,340 8 0	23,046 8 1	8,026 5 7	74,750 15 8	9,343 13 11
3,80,677 13 10	3,49,149 0 9	3,96,042 14 1	3,82,014 1 1	26,10,862 13 11	3,31,358 15 3
—17,188 14 9	+91,150 10 8	+1,39,113 15 11	+78,757 9 0		
3,63,488 15 1	4,40,299 11 5	5,35,156 14 0	4,60,771 10 1		
2,72,538 4 5	3,01,185 11 6	4,60,019 1 2	3,48,057 4 5		
+91,150 10 8	+1,39,113 15 11	+75,137 12 10	+1,12,714 5 10		

in which fees to which the Board were not entitled were erroneously drawn from the Treasury, and afterwards refunded.

From the lower columns of the above, it will be seen that the Board commenced operations with a credit balance with Government of Rs. 1,00,444; that this balance soon became a debit one; and that the Board's expenditure on municipal improvements continued to be kept in advance of their assets till the close of 1849-50. Since then the funds of the Board have been hoarded up (with what object I am not aware), and a large balance has now accumulated. Scarcely a third of the improvements recommended to Government in the Board's Report of 1849-50 have yet been sanctioned, the plans and estimates I have forwarded for many of them being ordered by the Board to stand over.

N.B.—The credit balances are marked + (plus), the debit ones — (minus); the former class being always added to, and the latter subtracted from, the year's income, to give the total available funds for each season's operations.

APPEN

Particulars of the Board's General Expenditure, for

Items.	For 10 Months and 21 Days of 1845-46.	1846-47.	1847-48.
	Rs. a. p.	*Rs. a. p.*	*Rs. a. p.*
Police contribution	37,500 0 0	45,000 0 0	45,000 0 0
Clerk to the Board of Conservancy, establishment, stationery, &c.	6,434 6 1	8,483 4 4	7,908 6 4
Clerk to the Public Markets, and contingent charges, &c.	4,098 6 11	5,517 3 9	5,268 11 9
Collector of Municipal Taxes, &c. &c.	.....	.....	.....
Assessor of Houses and Buildings, &c.	.....	.....	.....
Executive Expenditure.			
Maintenance and extension of public works and improvements, &c.	2,08,504 10 7	2,81,551 5 4	2,29,790 2 1
Executive establishment of the Superintendent of Repairs	11,076 4 10	14,407 4 3	13,703 1 2
Establishment of ditto for supervising and enforcing the local regulations relating to public health and convenience	11,522 14 10	14,172 15 0	14,131 9 10
Total	2,79,136 11 3	3,19,130 0 8	3,08,801 15 2

REMARKS.—It will be seen, that from the first complete year after the institution of the Board up to the close of 1849-50, the establishments and permanent charges of the Board underwent no material alteration.

During 1850-51, an arrangement was made by the Board with Government, under which the assessment and collection of certain of the municipal taxes was transferred from a Government Officer to a Collector appointed by the Board, and subject to the Board; the Government Officer being compensated by an increase of the Board's contribution to Police.

In the notes on Table A, I have shown that the first effect of this alteration will be an apparent increase of the income of the Board, amounting to the former cost of collection.

The actual effect of this arrangement on the permanent charges on the Municipal Fund, on account of the Police contribution establishment, and assessing and collecting charges, will appear by the following comparative statement of these charges for 1849-50 and 1851-52, the years previous and subsequent to such alterations :—

From Appendix G of the Board's Report to Government of 1849-50.

Contributions to Police	Rs. 45,000
ASSESSING AND COLLECTING CHARGES, AND COLLECTOR'S COMMISSION.	
House Tax.	
Assessing charges	Rs. 3,480
Contingent charges	650
Collector's commission	8,000
	12,130
Shop and Stall Tax.	
Expenses of collection	Rs. 6,516
Contingent charges	500
	7,016
Wheel Tax.	
Assessing establishment	Rs. 996
Collecting ditto	1,800
Extra ditto	800
Collector's salary	3,000
	6,596
	25,802

DIX B.

each Year, from 1845-46 *to* 1852-53, *both inclusive.*

1848-49.	1849-50.	1850-51.	1851-52.	1852-53.	Total for 8 Years.
Rs. a. p.	*Rs. a. p.*	*Rs. a. p.*	*Rs. a. p.*	*Rs. a. p.*	*Rs. a. p.*
45,000 0 0	45,000 0 0	48,333 5 4	53,000 0 0	53,329 11 8	3,72,163 1 0
8,049 13 3	7,886 1 6	8,096 1 0	7,729 7 2	7,841 10 0	62,429 1 8
4,767 12 5	4,784 11 0	4,778 11 1	4,807 4 2	4,892 7 5	38,915 4 6
.....	.....	6,247 12 1	18,993 15 6	22,092 1 3	47,333 12 10
.....	.....	1,608 2 4	4,918 13 11	3,938 10 8	10,465 10 11
2,27,040 12 2	1,85,933 13 7	2,03,424 13 6	3,12,913 0 5	2,27,718 12 2	18,98,977 5 10
14,496 15 8	14,964 14 5	14,990 11 8	15,152 15 0	14,826 14 5	1,13,619 1 5
14,181 11 6	13,768 11 11	13,706 2 6	13,403 9 0	13,417 0 8	1,08,304 11 3
3,13,544 1 0	2,72,338 4 5	3,01,185 11 6	4,60,919 1 2	3,48,057 4 3	26,52,208 1 5

Salary and establishments of the Clerk to the Board of Conservancy, the Superintendent of Repairs, and the Clerk of the Markets	Rs. 43,300
Less the following items :—	
(First three included in the scavenging contract since 1st December 1850, and 4th cancelled.)	
Establishment for cleaning necessary at Cummatee Poora, and removing the night-soil from the station at Kharra Taak, from 1st May to 31st December 1850	Rs. 1,345 15 10
Establishment for cleaning necessary adjoining Shaik Abdoola Parkamola Street, from 1st May to 31st December 1850	372 0 0
Removing night-soil from the necessary and Halalcore station at Sonapoor, from 21st September to 30th November 1850	1,091 0 6
Temporary establishment entertained for opening and shutting gates of the Love Grove Sluices, from 1st April to 14th May 1850	56 0 8
	2,868
	40,432
Total	Rs. 1,11,234

From Appendix G of the Board's Report to Government for 1850-51, *"Certain Expenditure" of* 1851-52.

Contribution to Police	Rs. 50,000
Commission to the Collector of Municipal Taxes	3,000
Salary and establishment of the Clerk to the Board of Conservancy, the Superintendent of Repairs, Collector of Municipal Taxes, Clerk of the Markets, Assessor of Houses and Buildings	60,700
Total permanent charges under new arrangement	Rs. 1,16,700
Deduct ditto before the alteration	1,11,234
Excess in cost of new arrangement	Rs. 5,466

APPENDIX C.

Particulars of the Board's Executive Expenditure, for each Year, from 1845–46 to 1852–53, both inclusive.

Years.	Executive Extension and Maintenance of New Works.	Repairing and Watering Roads.	Repair and Clearing of Drains, and Scavenging the Town.	Widening Roads, under Building Certificates.
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
For 10 months and 22 days* of 1845–46.	1,21,669 12 6	55,008 1 4	23,092 1 4	4,155 5 10
Ditto ditto 1846–47.	1,00,153 8 0	73,414 11 1	40,342 5 2	9,836 4 3
Ditto ditto 1847–48.	1,00,336 7 0	76,611 7 7	38,681 8 6	3,639 13 6
Ditto ditto 1848–49.	82,514 6 1	95,607 5 10	35,000 0 0	5,140 7 11
Ditto ditto 1849–50.	55,249 5 9	79,290 4 6	35,000 0 0	7,792 9 1
Ditto ditto 1850–51.	75,575 10 0	73,889 3 10	37,166 10 8	6,774 5 2
Ditto ditto 1851–52.	1,82,506 8 10	77,500 0 0	41,500 0 0	5,616 15 9
Ditto ditto 1852–53.	83,015 0 10	87,210 3 6	41,500 0 0	4,534 1 7
Total for eight years	8,01,020 11 0	6,18,531 5 8	2,92,283 9 8	47,489 15 1
Yearly average	1,00,127 9 4	77,316 6 8	36,535 5 2	5,936 3 1

Expenditure. Public Works and Improvements. Work done Departmentally.	Lighting.	Under Clause IX. Art. XI. of 1845, and Miscellaneous Charges.	Annual Repairs to Public Buildings.	Total of Executive Expenditure.	Total of Executive Establishment.
Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
652 0 0	46 12 4	46 15 0	3,833 10 3	2,08,504 10 7	11,076 4 10
.....	419 15 10	151 4 8	7,233 4 4	2,81,551 5 4	14,407 4 3
558 1 11	255 7 10	82 10 0	2,624 9 9	2,22,790 2 1	13,703 1 2
2,020 9 5	227 7 6	67 15 9	6,462 7 8	2,27,040 12 2	14,493 15 8
2,329 4 1	193 3 6	111 8 0	5,767 10 8	1,85,933 13 7	14,964 14 5
2,931 10 0 *	175 4 7	158 2 0	6,753 15 3	2,03,424 13 6	14,990 11 8
252 0 0	.....	598 11 2	34,038 12 8	3,42,013 0 5	15,152 15 0
231 0 0	.....	720 1 2	10,508 5 1	2,27,718 12 2	14,826 14 5
9,174 9 5	1,318 3 7	1,937 3 9	77,222 11 8	18,98,977 5 10	1,13,616 1 5
1,146 13 2	219 11 3	242 2 5	9,652 13 5	2,37,372 2 8	14,202 0 2

* The Board commenced operations on the 10th of June 1845, when one month and nine days of the official year had already elapsed.

Remarks.—The average executive expenditure of the Board has for the last eight years averaged Rs. 2,37,372 per annum. Of this, Rs. 1,00,083 per annum has been for new works, Rs. 1,00,127 for works requiring special sanction, and Rs. 5,936 for widening roads by the retirement of individual houses under building certificates; the remainder, Rs. 1,31,230, has been expended on the repairs and maintenance of public works.

The total executive expenditure in the last eight years has been Rs. 18,98,977, and the total charge for executive superintendence Rs. 1,13,616 during that period (or about 6 per cent. on the former). This is a very low charge for India. The charge of superintendence in the Garrison Engineer and Civil Architect's Department is, I am informed, about 20 per cent.; and in the Road and Tank Department it is stated in one of their published reports, quoted by Captain Cruickshank in his letter No. 34 of 1846, to vary from 16 to 9 per cent. on the executive expenditure.

I have since ascertained, that on the average of the last six years' operations, the charge for superintendence in the Road and Tank Department has been 2s. 7d. per rent. on the expenditure.

APPEN

Particulars of Munici

Years.	Clerk to the Board of Conservancy, Establishment, stationery, &c.	Clerk to the Public Markets.	Collector of Municipal Taxes, &c. &c.	Assessor of Houses and Buildings, &c. &c.
	Rs. a. p.	*Rs. a. p.*	*Rs. a. p.*	*Rs. a. p.*
For 10 months and 29 days* of 1845-46.	6,434 6 1	4098 6 11	.....	.....
Ditto ditto 1846-47.	8,483 4 4	5,517 3 9	.....	.....
Ditto ditto 1847-48.	7,908 6 4	5,268 11 9	.....	.....
Ditto ditto 1848-49.	8,949 13 3	4,767 12 5	.....	.....
Ditto ditto 1849-50.	7,886 1 6	4,784 11 0	.....	.....
Ditto ditto 1850-51.	8,096 1 0	4,778 11 1	6,247 12 1	1,608 2 4
Ditto ditto 1851-52.	7,729 7 2	4,807 4 2	18,993 15 6	4,918 13 11
Ditto ditto 1852-53.	7,841 10 0	4,892 7 5	22,092 1 3	3,938 10 8
Total for eight years.....	62,429 1 8	38,915 4 6	47,333 12 10	10,465 10 11
Yearly average	7,803 10 2	4,614 6 6	15,777 14 11	1,308 3 4

* The Board commenced operations on the 10th June 1845, when one

Remarks.—Establishment for supervising and enforcing the local regulations relating to public health and conveniences.—This is effected by a system of sanitary Police. The Island is divided into four divisions, each under the charge of a European Inspector. Each division is again sub-divided into beats, each consisting of a certain length of street or road, and under the charge of a Peon. Each Peon is expected to perambulate his beat early every morning, taking note of every offence against the Nuisance or Building Act, and reporting them to the European Inspector of his division. On receiving the reports from all his beats, the Inspector examines each case personally, and his report is brought to the Superintendent and Surveyor's office. The Purvue of the division there

DIX D.

pal Establishment.

Establishment supervising and enforcing the Local Regulations relating to Public Health as it were.	Executive Establishment.			Total of Executive Expenditure.
	Permanent.	Extra.	Total.	
Rs. a. p.	*Rs. a. p.*	*Rs. a. p.*	*Rs. a. p.*	*Rs. a. p.*
11,522 14 10	8,521 11 3	2,554 9 7	11,076 4 10	2,08,504 10 7
14,172 15 0	11,716 15 0	2,690 5 3	14,407 4 3	2,81,551 5 4
14,131 9 10	12,171 3 4	1,531 13 10	13,703 1 2	2,25,790 2 1
14,181 11 6	12,826 6 2	1,670 9 6	14,496 15 8	2,27,040 12 2
13,768 11 11	13,335 9 6	1,629 4 11	14,964 14 5	1,85,933 3 7
13,706 2 6	13,412 2 6	1,578 9 2	14,990 11 8	2,03,424 13 6
13,403 9 0	13,414 10 7	1,738 4 5	15,152 15 0	3,42,013 0 5
13,417 0 8	13,539 9 6	1,287 4 11	14,826 14 5	2,27,718 12 2
1,08,304 11 3	90,938 3 10	14,680 13 7	1,13,619 1 5	18,98,977 5 10
13,538 1 4	11,367 4 5	1,835 1 8	14,202 6 2	2,37,372 2 8

month and nine days of the official year had already elapsed.

fills up summonses for the Court of Petty Sessions in each case, which summonses are then initiated by the Surveyor to the Court of Petty Sessions, and then served by the Peons in the several beats. The summonses are numbered like cheques, and the counterpart remains in the office records. The number of summonses issued is about 1,600 per annum. Nearly all the eight months of fair season, each European Inspector is expected to visit every beat in his division once in 10 days, without previous warning to the Peon in charge, who is punished for neglect of duty if the Inspector discovers any unreported nuisance of more than a day's standing in his beat.

APPEN

Work-people employed by the Contractors for the

Years.	By the Road-repairing			
	Labourers, Days' Work.	Cart-loads Metal.	Cart-loads Sandstone.	Labourers, Days' Work for Watering Roads.
For 1845–46	103,157	29,653	6,841	....
For 1846–47	92,322	39,962	7,550	....
For 1847–48	111,927	42,810	8,887	....
For 1848–49	108,392	35,310	8,743	....
For 1849–50	122,885	43,156	10,070	....
For 1850–51	113,951	32,776	9,819	6,751
For 1851–52	130,863	41,835	18,638	6,740
For 1852–53	124,825	30,814	7,445	6,764
Total for eight years	908,322	303,306	77,993	20,255
Yearly average	113,504½	37,913½	9,749½	6,751¾

Remarks.—Bombay, with a population of 519,000, contains 130 miles of macadamized streets; the extent of unmade roads and courts is not ascertained. Liverpool, with a population of 360,000, contains 174 miles of paved or macadamized carriage-way, and 69 miles of courts and passages. The average width of the streets and roads of Bombay is 27 feet; there are therefore 2,059,200 square yards of road surface. The cost of repairs and maintenance is at the rate of 8 pies or 1d. per square yard per annum. This is very low—less than one-fifteenth of the London rate, and only about one-eleventh of the Liverpool rate. From a document laid before the Marylebone Vestry by the Surveyor to that district in September 1851, an abstract of which is published in the Civil Engineer and Architect's Journal of October 1851, it appears, that on the average of the last twelve years, the cost of keeping in repair the macadamized roads of that district has been, for those of the greatest traffic 1s. 8d. or 13 *ox.* 4 *p.* per yard, for those of the least traffic 7¼*d.* or 4 *ox.* 10 *p.* per yard, and for the average of the whole 1s. 2d. or 10 *ox.* per yard.

In the last report to the Health Committee of the Borough of Liverpool by the Borough Engineer, Inspector of Nuisances, and Medical Officer of Health, Liverpool, 1851, the highest rate of repair for the macadamized roads in Liverpool, on an average of three years, is stated at 1s. 6¼*d.* or 12 *ox.* per yard, the lowest 8*x.* 3*d.* or 8*x.* 1·10·9

DIX E.

Repairing and Scavenging of the 130 *Miles of Streets.*

Contractor.			By the Scavenging Contractor.			
Watering Carts, Days' Work.	Amount of Contract.		Labourers, Days' Work.	Carts, Days' Work.	Sepoys, Days' Work.	Amount of Contract.
	Rs.	*a.* *p.*				*Rs.* *a.* *p.*
....	67,641	10 8	....	....	....	26,000 0 0
....	73,531	4 0	....	....	....	36,597 14 8
....	73,309	14 6	....	....	....	36,513 12 0
....	82,443	7 10	....	....	....	35,000 0 0
....	77,793	13 4	....	....	....	35,000 0 0
25,772	77,505	8 0	100,793	28,841	10,900	41,500 0 0
25,650	77,505	8 0	105,285	28,934	10,895	41,500 0 0
25,782	77,505	8 0	111,323	31,377	11,854	41,500 0 0
77,204	6,07,432	10 4	317,401	89,152	33,649	2,96,011 10 8
25,734¾	75,929	1 3	105,800¼	29,717¼	11,216⅓	37,001 7 4

per yard; the mean would be therefore near 11*x.* 3*d.* At Liverpool, the streets of greatest traffic are paved with squadrou stones, and the repairs and maintenance of streets so paved is comparatively inexpensive.

Scavenging.—The scavenging of Bombay, with a population of 519,000, 130 miles of metalled carriage-way, and an extensive surface of unmade streets and courts, has cost Rs. 37,001 per annum on the average of the last eight years. The scavenging of Liverpool, with a population of 360,000, 174 miles of carriage-way, and 69 miles of passages and courts, Rs. 1,00,021 per annum,* and the scavenging and dusting of the city of London, with a population of about 1,400,000, has cost on the average of the last six years Rs. 63,780 per annum.† By the sale of dust to the brick founds of the Metropolis, this has, however, been reduced to Rs. 57,880 per annum. Everywhere in the city of London, and generally in Liverpool, the courts and passages being paved with flag-stones, present an unbroebent surface, which requires comparatively little cleaning.

* Report to the Health Committee of the Borough of Liverpool by the Borough Engineer, Inspector of Nuisances, and Medical Officer of Health. Liverpool 1850.

† Mr. Haywood's (Surveyor) Report upon Street-cleaning to the City Sewer Commissioners. London, October 1851.

APPENDIX F.

Containing, 1st, *a List of the New Works executed at the Cost of the Municipal Fund, since the institution of the Board of Conservancy;* 2nd, *the Mode in which such Works are let to Contract; and* 3rd, *the Rates at which they are estimated, and have been executed.*

1ST.

A List of the New Works executed at the Cost of the Municipal Fund, since the institution of the Board of Conservancy.

	Rs.	*a.*	*p.*
27th March 1843.—Completing Portuguese Street (on which Rs. 3,004-7-6 had been previously expended from the County Fund..	97	13	6
Ditto.—Ditto Trimbuck Purushram Street (do. Rs. 3,273 do. from do.)	98	0	0
Ditto.—Ditto a street between the Duncan Road and Trimbuck Purushram Street (do. Rs. 1,661-13-1 do. from do.)	55	0	0
Ditto.—Ditto Koombharwada Street (do. Rs. 3,163-8-8 do. from do.)	133	0	0
5th October 1843.—Ditto cross-street between Lawrence de Lima Street and Moogawur Pakary 4th Row (do. Rs. 855 do. from do.)	32	0	0
3rd April 1844.—Ditto cross-street between Goolam Moideen Subedar Street and the Duncan Road (do. Rs. 974-15-6 do. from do.)	40	0	0
14th ditto.—Ditto Moonshee Yacoob Street (do. Rs. 763 do. from do.).	25	0	0
23rd September 1844.—Ditto Bengal Poora Street (do. Rs. 1,399 do. from do.)	140	0	0
15th November 1844.—Ditto Temker Street (do. Rs. 4,411-13-4 do. from do.)	215	0	0
14th April 1844.—Improving Borah Musjeed Street (do. Rs. 6-10-6 do. from do.)	1,008	5	0
Carried over..	1,844	2	6

	Rs.	a.	p.
Brought over..	1,844	2	6
20th February 1845.—Blasting out a large portion of rock which obstructed the course of the Oomercarry Sewer (on which Rs. 7,926 had been previously expended from the County Fund)	306	0	0
6th February and 3rd April 1845.—Making a road and constructing a sewer in Chunam Kiln Row (do. Rs. 1,516 do. from do.) ..	2,068	6	5
3rd June 1845.—Constructing a new road at the back of the Byculla Schools (do. Rs. 1,000 do. from do)	3,841	2	8
11th March 1845.—Ditto 1st Marine Lane..	5,138	12	5
Ditto.—Ditto 3rd ditto ditto	4,217	6	10
29th July 1845.—Constructing the approach to Lady Jamsetjee's Causeway	25,574	11	11
30th September 1845.—Improving the drainage of that part of the town which lies between the Erskine Road, Banian Row, Jugjeevan Keeka Street, and the Parell Road, and for constructing three unmade streets in the above localities, with covered drains ..	27,421	13	11
6th November 1845.—Deepening the outer channel of the Love Grove Sluices	1,500	0	0
Ditto.—Ditto and widening the channel from Duncan Road Bridge.	1,248	2	3
11th ditto.—Building a wall round the northern side of the quarry near the Byculla Tank	1,057	0	0
24th ditto.—Constructing a main sewer from the town drain at Eslampoora Street, in New Town, along the Bhooleshwur Road and Shaik Memon Street, to the verge of the Esplanade	35,766	14	7
6th December 1845.—Widening that part of the Warden Road, extending from the foot of Gowalla Tank Hill Road to the carriage road at the Breach	931	14	0
22nd ditto.—Opening Syed Abdool Rahimon Street into Parell Road.	8,889	12	2
29th ditto.—Widening the Nepean Road, opposite to the ground on the sea side, recently granted to Cursetjee Cowasjee, Esq., and for making cross-drains..	670	8	0
10th January 1846.—Erecting a Grass Market on the Esplanade ..	653	0	0
2nd February 1846.—Arching the sewer in Bapoo Khote Street ..	4,690	4	7
Ditto.—Making an auxiliary drain from the town drain in Coppersmith Row to the sewer in Jugjeevan Keeka Street	1,386	0	0
2nd April 1846.—Erecting a pier on piles over the sea at Boree Bunder, for the use of halalcores	3,952	0	0
12th May 1846.—Raising the Jail Road at the south end of the Baboola Tank, and constructing a covered sewer	1,329	0	0
22nd September 1846.—Constructing a sewer, with cross-drains, and a road, in Chundunwady Lane, from Girgaum Road to Back Bay	11,860	9	3
Ditto.—Constructing a sewer, with cross-drains, and a road in Bhundarwada Road, from the Police Chowkey at Bhundarwada to the Carnac Bunder	6,609	14	8
Carried over..	1,50,957	8	2

	Rs.	a.	p.
Brought over..	1,50,957	8	2
7th October 1846.—Constructing a main sewer, with cross-drains, in New Line Street, commencing in Lowarchall Street, and discharging into Back Bay near the Pork Market..	13,239	4	7
8th ditto.—Widening the Bazar Gate Esplanade Road from 25 to 45 feet	6,053	0	0
26th November 1846.—Constructing six public urinaries, three within the Fort, and three in the Native Town	651	0	0
27th ditto.—Ditto a sewer and cross-drains in Ballajee Shamshet Street..	1,539	4	0
28th ditto.—Ditto roadways in six streets situated between Obelisk Road, Erskine Road, Duncan Road, and Parell Road	16,719	6	3
8th December 1846.—Arching over the town drain, from corner of the Erskine Road to Waddington Bridge..	26,490	9	7
8th February 1847.—Constructing a sewer and cross-drains, and making a road in Khutterwady Lane	2,590	12	0
20th September and 12th February 1847.—Removing houses near the Parell Road	2,750	0	0
13th February 1847.—Widening a part of Medow Street.. ..	2,000	0	0
17th ditto.—Constructing station, and three iron tanks on wheels, and digging a cesspool on the side of the town drain	926	4	1
Ditto.—Ditto a public necessary at Cammattee Poora	4,082	12	2
19th March 1847.—Making Koombharwada Street at Dongree, with open side-drains	1,058	12	0
17th July 1847.—Completing Eslampoora Street, in the New Town.	1,031	0	0
18th August 1847.—Draining and improving Wittulwady Street..	6,246	12	8
26th ditto.—Constructing a sewer in Butcher Street, Nagdew Street, and Musjeed Bunder Cross-road	27,534	14	0
1st October 1847.—Making a main sewer in the centre of the Breachcandy road, and cross-drains from Dhobee Tank to Colbhat Lane.	8,595	11	1
7th December 1847.—Making a covered arched drain, from the north side of English Burying Ground to Old Sonapoor Street, and main sewer and cross-drains in the Old Sonapoor Street; also main sewer and cross-drains in the Breachcandy Road, from Colbhat Lane to Agiary Lane	18,028	8	10
5th January 1848.—Erecting a new Beef Market within the Fort (in Mody Bay Street)	1,192	0	0
20th ditto.—Substituting pavement for plaster work in the bottom of the main sewer in Butcher Street and Musjeed Bunder Cross-road.	662	0	0
Ditto.—Removing and re-making arched main sewer in part of Syed Abdool Rahimon Street, and making cross-drains, and re-making roadway	3,342	10	3
3rd March 1848.—Making a main sewer in Musjeed Bunder Cross-road to the sea-shore at Clare Bunder, also a sewer and cross-drains in part of Cazee Syed Street	9,012	13	7
Carried over..	3,04,704	15	3

	Rs.	a.	p.
Brought over..	3,04,704	15	3
7th March 1848.—Converting the present open side-gutter of 1st Carpenter Street, in the New Town, into covered drains, including the valuation for steps removed	1,218	6	2
3rd April 1848.—Raising, paving, and sloping the sewer in the centre of Syed Abdool Rahimon Street	3,200	4	10
Ditto.—Making a main sewer and cross-drains, with foot-path, &c. from Parell Road to Oomercarry Sewer	1,716	0	0
Ditto.—Ditto an arch over portion of the present open drain in Coppersmith Street, and making cross-drains, also re-making a roadway	3,775	2	4
16th May 1848.—Widening the Breachcandy Road, near Dhobee Tank, including valuation of certain buildings to be removed ..	1,099	10	2
18th ditto.—Ditto ditto near New Sonapoor, and value of certain buildings to be removed	3,288	0	11
31st August 1848.—Opening out the street from Khoja Street into the Bhendy Bazar Road, including valuation for buildings to be removed	500	9	2
Ditto.—Making and draining the cross-street between Shaik Abdoola Puckmoria Street, Bhendy Bazar Road, and over the Oomercarry Sewer	774	14	10
9th November 1848.—Ditto a cross-road between Syed Abdool Rahimon Street and Beebee Jan Row	985	0	0
30th ditto.—Constructing a drain from the north side of the Grant College compound	1,551	8	0
9th December 1848.—Making Moogawur Pakary 1st Row, in Mazagon	593	5	7
25th August 1849.—Widening and improving Bhooleshwur Lane..	9,665	3	2
27th October 1849.—Making a covered drain, with cross-drains, on the side of the Esplanade Cross-road, and re-making roadway ..	1,562	8	0
Ditto.—Converting the present open side-gutters of Picquet Road into covered drains, and re-making roadway	1,462	0	0
31st December 1849.—Making cross-drains, and re-making roadway in Mirza Oil-maker Street	1,688	0	7
Ditto.—Providing the drainage of the pieces of vacant ground on either side of the cross-road which connects Duncan Road with Trimbuck Purushram Street..	1,947	8	0
31st June 1850.—Widening, raising, and strengthening the banks of the main town drain..	985	1	3
26th March 1850.—Putting up lamps along the road from the Church Gate to Esplanade Cross-road	531	11	0
8th August 1846.—Opening Bapoo Khote Street	1,237	5	11
22nd September 1846.—Widening the unmade streets between Dongree Cooly Street to old Jamlee Musjeed Street	2,095	8	10
Carried over..	3,44,582	12	0

	Rs.	a.	p.
Brought over..	3,44,582	12	0
New Works, of which Accounts were not closed on 1st May 1851.			
7th November 1848.—Constructing a made road and drain in Gunesh-wady or Scotarchall Lane	896	7	2
15th December 1848.—Improving, and thoroughly draining the Parell Road from the Esplanade to Jugjeevan Keeka Street ..	46,908	14	10
12th January 1849.—Making cross-drains, and re-making roadway in 2nd Bhoewada Street	1,400	0	0
Ditto.—Substituting covered drains for the open side-gutters of the 1st Bhoewada Street, from the Bhooleshwur Road to Jugjeevan Keeka Street..	1,919	8	0
27th October 1849.—Covering open drain from Bapoo Khote Street to Parell Road, at Poydowney	10,627	5	5
Ditto.—Making a main sewer in the centre, and cross-drains, and re-making a roadway, in Poydowney Street	8,084	12	4
31st December 1849.—Ditto a small portion of Oomercarry Sewer between Duncan and Grant Roads, and re-making roadway over it.	3,950	0	0
Ditto.—Constructing a lane from Old Nagpada Street to 2nd Dontarr Road, or Gora Molla	831	0	0
Ditto.—Making cross-drains, and re-making roadway, in Syed Abdool Rahimon Street	7,277	10	6
20th February 1850.—Abating the nuisances in the rear of Cammattee Poora, and Oomercarry Sewer, between Grant and Bellasis Roads	2,581	9	9
Ditto.—Levelling Nowrojee Hill 1st Row, and making a roadway..	866	12	3
20th February 1850.—Levelling Dontarr 3rd Row	608	8	0
8th March 1850.—Removing the nuisance arising from the present state of public necessary at Sonapoor, and improving the approaches thereto	13,576	3	6
22nd May 1850.—Making a platform for tipping the carts for emptying the night-soil into the sea-channel of the Love Grove Sluices, and constructing a roadway thereto	1,871	13	7
31st ditto.—Deepening the sea-channel of the Love Grove Sluices..	1,567	9	11
9th July 1850.—Removing a dangerous projection from the west side of the Breachcandy Road, immediately opposite to the Chunam Kiln Row	510	11	2
Ditto.—Raising, levelling, and draining the unmade road traversing the centre of the suburb of Cammattee Poora	2,909	0	0
25th October 1850.—Constructing a new road between the Chowpatty and Breachcandy Roads	12,636	1	9
5th November 1850.—Improving the suburbs of Small Colaba, by levelling roads and making drains	2,784	2	6
Ditto.—Outlay incurred consequent on the alteration made to the new Medical Depôt, to admit of Apollo Street being widened ..	1,445	0	0
Carried over..	4,67,835	14	8

	Rs.	a.	p.
Brought over..	4,67,835	14	8
5th December 1850.—Opening a road from Bhooleshwur Road to Parell Road, through the Pinjrapole..	6,990	10	7
17th January 1851.—Widening and draining Colbhat Lane ..	6,454	3	3
29th ditto.—Widening the Chowpatty Road from the Portuguese Church in Girgaum to the foot of Malabar Hill..	4,099	1	3
5th February 1851.—Making masonry covered drains on both sides in Ardaseer Dady Street, and re-making roadway..	1,759	0	0
27th ditto.—Cleaning, levelling, and putting into proper order the side-drain of Bellasis Road	818	5	1
30th April 1851.—Leading into the Baboola Tank the monsoon surface-drainage of the high ground in its neighbourhood	1,144	0	0
18th August 1851.—Digging sixty-six pits on the Flats for the deposit of night-soil	1,622	0	0
19th ditto.—Covering ditto ditto with bamboo matting, mineral-browned, and supported with rafters	873	1	6
6th March 1851.—Covering over town drain from Waddington Bridge, or junction of Trimbuck Purushram Street with main drain, as far as 200 feet beyond the Bellasis Road	1,42,157	14	1
Ditto.—Sinking and building a well, with platform, at Gowalla Tank..	2,505	0	0
16th April 1851.—Constructing a flat masonry bottom to the main drain, from 200 feet below the Bellasis Road Bridge to the wooden bridge across the Flats	9,397	8	0
7th May 1851.—Paving the remaining uncovered portion of the drain from Parell Road to the main drain, on the north side of the Bellasis Road, and for covering over the upper portion of it as far as 100 yards below the junction of the Duncan and Bellasis Roads	4,978	4	0
31st May 1851.—Constructing a road from the Grant to the Bellasis Road..	2,013	4	0
13th March 1850.—Macadamizing and draining Tellowdy or Wittulwady Cross-street (of the cost of this work, Rs. 2,475, Rs. 1,605 are to be borne by the inhabitants, for draining, and the other portion, for macadamizing, by the Municipal Fund)	766	7	6
2nd March 1852.—Improving the Koombharwada Road from Duncan Road to Waddington Bridge, and raising roadway..	1,324	2	9
31st ditto.—Digging forty-nine pits on the Flats, each 30 feet long, 12 feet broad, and 10 feet deep, for the deposit of night-soil ..	1,433	14	9
Ditto.—Covering ditto with bamboo matting, mineral-browned, and supported on rafters..	712	8	8
2nd November 1850, and 2nd August 1851.—Planting and fixing a single row of trees on each side of the Esplanade Road, from Kalbadavee Road to Apollo Gate	1,551	8	0
Carried over..	6,58,436	12	1

	Rs.	a.	p.
Brought over..	6,58,436	12	1
14th December 1850.—Constructing the apparatus, including pipes, for the conveyance of the water of the Framjee Cowasjee Tank to the centre of the Native Town at Poydowney	20,000	0	0
6th March 1851.—Sinking and building a tank, with platform, &c. at Girgaum Back Road	3,517	0	0
Ditto.—Sinking and building a well, with platform, &c. on the side of the Khetwady Road	2,866	0	0
17th ditto.—Enlarging and deepening the present well in Wittulwady Street	1,658	0	0
14th May 1851.—Sinking and building a well, with platform, &c. in Colaba, near the Gun Carriage compound	1,822	0	0
31st ditto.—Purchasing and improving a quarry of sweet water, situated in Nanabhoy Jamsetjee's ground at Mazagon	2,000	0	0
22nd September 1851.—Sinking and building a well in Parell ..	1,599	2	2
26th December 1851.—Sinking and building a well in Sewree ..	1,467	0	0
15th February 1853.—Constructing a well in Candawady Lane ..	625	8	2
23rd ditto.— Ditto ditto near Bazar gate ..	1,366	14	3
8th January 1852.—Making a road from the town drain to Tardeo..	3,790	8	0
15th May 1852.—Raising and levelling a thoroughfare, running by the sea-side, between the road close to the Portuguese Chapel and the road to the Lunatic Asylum	503	4	1
26th May and 9th July 1852.—Forming a new burial ground on the Bombay Flats	4,040	12	10
13th July 1852.—Widening Colaba Causeway	7,301	14	10
30th July 1851.—Lighting the road from the Bazar Gate to Shaik Memon Street by a single row of lamps	557	14	2
31st December 1853.—Completing the drainage of the undermentioned eighty-seven streets and lanes, situated in the Mandwee, Market, and Oomercarry sub-divisions of the Native Town ..	40,000	0	0
Shaik Memon Street.			
Shaik Ally Jungeerkur Row.			
Esplanade Cross-road.			
Balloo Surung Street.			
Bhajee Palla Row.			
Nagdew Row.			
Narron Dhooroo Street, and cross-street from Narron Dhooroo Street to Syed Abdool Rahimon Street.			
Cross-street from Narron Dhooroo Street to Nagdew Street.			
Dhunjee Dongria Lane, Agiary Lane, and cross-street.			
Moombadavee Tank Road.			
Beebee Jan Row.			
Coppersmith Street.			
Nagdew Street.			
Hussan Khan Khalifa Row.			

	Rs.	a.	p.
Brought over..	7,51,552	10	7

Old Cazee Street.
Jamblee Musjeed Street.
Unmade cross-streets from Esplanade Cross-road to Shaik Ally Jungeerkur Street.
Cross-street from Shaik Ally Jungeerkur Street to Bhundarwada Street.
Cross-street from Jamblee Musjeed Street to Dongree Cooly Street.
Bhajee Palla Row.
Memonwada Street.
Cross-street from 1st Koombharwada Street to Memonwada Street.
Beebee Jan Row.
Unmade cross-street from 1st Koombharwada Street to Memonwada Street.
Nagdew Row.
1st Koombharwada Street.
2nd ditto ditto.
Shaik Ally Jungeerkur Row.
Esplanade Cross-road.
Dongree Joao Souza Street.
Duriastan or Chambarwada Street, and branch to Dongree Joao Souza Street.
Shamjee Hassajee Street and Bhundarwada Street.
Unmade cross-street from Shaik Ally Jungeerkur Row to Shamjee Hassajee Street.
Essajee Hassajee Street.
Unmade cross-street from Bhundarwada Street to Essajee Hassajee Street.
Musjeed Bunder Row.
Kazee Syed Street.
Unmade cross-street from Cazee Syed Street to Dongree Cooly Street.
Dongree Cooly Street.
Mahomed Syed Mookree Street
Memonwada Street, and cross-street from Memonwada to Nagdew Street.
Mahomed Hussein Kambakur Street.
Dontarr 2nd Row.
Dontarr 3rd Row.
Cross-street from Shamjee Hassajee Street to Dontarr 3rd Row, and from Chambarwada Street to cross-street.
Unmade cross-streets between Dontarr 3rd Row and Shamjee Hassajee Street, and from Musjeed Bunder Cross-road to cross-street.
Shamjee Hassajee Street.

Carried over..	7,51,552	10	7

	Rs.	a.	p.
Brought over..	7,51,552	10	7
Poydowney Street, Combed Bowel Street, and Chambarwada Street,			
Dongree Cooly Street.			
Dongree Cooly Cross-Street.			
Shamjee Hassajee Street.			
Street from Chinch Bunder 1st Row to Chambarwada Street.			
Combed Bowel Street.			
Dontarr 1st Row.			
Dontarr 2nd Row.			
Memonwada Street.			
Nagdew Street.			
Chunam Kiln Row.			
Chinch Bunder 3rd Row.			
Chinch Bunder 2nd Row.			
Nishandar Oomercarry Row.			
Cross-street from Chinch Bunder 1st Row to Nishandar Oomercarry Row.			
Foogla Tandel Street.			
Nishandarnicha Pada.			
Cross-street from Nishandar Oomercarry Row to Jail 2nd Row.			
Cross-street from Chinch Bunder 2nd Row to Bengalpoora Oomercarry Row.			
Market Lane.			
Bengalpoora Oomercarry Row.			
Jail 2nd Row.			
Old Nagpada Cross-street.			
Dontarr 1st Row.			
Dontarr 2nd Row.			
Old Nagpada Street.			
Gora Molla.			
Cross-street from Gora Molla and Old Nagpada Street.			
Cross-street from Old Nagpada Street to main sewer underneath the house at Parell Road.			
Cross-street behind the Byculla Schools.			
Continuation of Chunam Kiln sewer to Parell Road footpath.			
Cross-street from Foogla Tandel Street to Dontarr 2nd Row.			
Jail Row.			
A hundred petty works* under the cost of Rs. 500 were also executed during the last eight years, at the cost of	47,437	13	11
Carried over..	7,98,990	8	6

* For particulars of these petty works, see Appendices B, C, and F, of the Board's Report to Government for the first half of 1845-46 *(Government Gazette,* 6th January 1846*)*; Appendices, B, C, D, G, I, and K, of similar Report for second half of 1845-46 *(Government Gazette,* 11th August 1846*)*; Appendices D, G, J, K, M, and N, in the Board's Report 1846-47 *(Government Gazette,* 2nd September 1847*)*; Appendices H, K, L, N, and O, in the Board's Report 1847-48 *(Government*

										Rs.	a.	p.
									Brought over..	7,98,990	8	6
Portions of various roads and streets were widened, by the retirement of 63 houses under building certificates, for the year 1845-46, at the cost of									Rs.	4,155	5	10
Ditto	ditto	of	112	ditto,	for	1846-47,	ditto	..		9,836	4	3
Ditto	ditto	of	55	ditto,	for	1847-48,	ditto	..		3,639	13	6
Ditto	ditto	of	113	ditto,	for	1848-49,	ditto	..		5,140	7	11
Ditto	ditto	of	61	ditto,	for	1849-50,	ditto	..		7,792	9	1
Ditto	ditto	of	54	ditto,	for	1850-51,	ditto	..		6,774	5	2
Ditto	ditto	of		ditto,	for	1851-52,	ditto	..		5,616	15	9
Ditto	ditto	of		ditto,	for	1852-53,	ditto	..		4,534	1	7
											47,489	12 1
The sum expended during the year 1845-46, on account of paving and improving the drainage of certain gullies, was									Rs.	17,419	0	5
Ditto	ditto			1846-47,		ditto		ditto..		3,154	6	7
Ditto	ditto			1847-48,		ditto		ditto..		2,258	11	1
Ditto	ditto			1848-49,		ditto		ditto..		1,882	15	10
Ditto	ditto			1849-50,		ditto		ditto .		2,460	15	11
Ditto	ditto			1850-51,		ditto		ditto..		1,686	8	2
Ditto	ditto			1851-52,		ditto		ditto..		1,633	3	7
Ditto	ditto			1852-53,		ditto		ditto..		1,625	0	0
											32,120	13 $\frac{4}{7}$
For repairing and watering the roads and streets, for the year 1845-46									Rs.	55,008	1	4
Ditto	ditto,			1846-47		..		..		73,414	11	1
Ditto	ditto,			1847-48		..		..		76,611	7	7
Ditto	ditto,			1848-49		..		..		95,607	5	10
Ditto	ditto,			1849-50		..		..		79,290	4	6
Ditto	ditto,			1850-51		..		..		73,889	3	10
Ditto	ditto,			1851-52		..		..		77,500	0	0
Ditto	ditto,			1852-53		..		..		87,210	3	6
											6,18,531	5 8
For scavenging the town, and repairing and cleaning drains, for the year 1845-46..									Rs.	23,092	1	4
Ditto	ditto,			1846-47..		..		..		40,342	5	2
Ditto	ditto,			1847-48..		..		..		38,681	8	6
Ditto	ditto,			1848-49..		..		..		35,000	0	0
									Carried over..	1,37,115	15	0 14,97,132 7 10

Gazette, 10th September 1848); Appendix B to the Board's Report 1848-49 (*Government Gazette*, 18th October 1849); Appendix B of similar Report for 1849-50 (*Government Gazette*, 19th September 1850); Appendix B of ditto for 1850-51 (*Government Gazette*, 13th November 1851); Appendix B of ditto for 1851-52 (*Government Gazette*, 5th May 1853); Appendix B of ditto for 1852-53 (*Government Gazette*, 25th May 1854).

										Rs.	*a.*	*p.*
					Brought over..	Rs.	1,37,115	15	0	14,97,132	7	10
For scavenging the town, and repairing and cleaning drains, for the year				1849-50..	..	..	35,000	0	0			
Ditto	ditto,			1850-51..	..	..	37,166	10	8			
Ditto	ditto,			1851-52..	..	..	41,500	0	0			
Ditto	ditto,			1852-53..	..	..	41,500	0	0			
										2,92,282	9	8
Annual repairs to public works, for the year				1845-46..	..	..	..	..	Rs.	706	8	7
Ditto	ditto,			1846-47	..	..				1,542	6	4
Ditto	ditto,			1847-48	..	..				1,728	2	4
Ditto	ditto,			1848-49	..	..				5,172	2	1
Ditto	ditto,			1849-50	..	..				3,342	7	0
Ditto	ditto,			1850-51	..	..				4,808	12	0
Ditto	ditto,			1851-52	..	..				3,126	0	3
Ditto	ditto,			1852-53	..	..				3,315	15	4
										23,742	5	11
Annual repairs to public tanks and wells, for the year				1845-46	..	..	..	..	Rs.	3,127	1	8
Ditto	ditto,			1846-47	..	..				5,690	14	0
Ditto	ditto,			1847-48	..	..				896	7	5
Ditto	ditto,			1848-49	..	..				1,290	5	7
Ditto	ditto,			1849-50	..	..				2,425	3	8
Ditto	ditto,			1850-51	..	..				1,945	3	3
Ditto	ditto,			1851-52	..	..				30,912	12	5
Ditto	ditto,			1852-53	..	..				7,192	5	9
										53,480	5	9
Lighting, for the year				1845-46	..	..	..	..	Rs.	46	12	4
Ditto,	ditto			1846-47	..	..	..			419	15	10
Ditto,	ditto			1847-48	..	..	..			255	7	10
Ditto,	ditto			1848-49	..	..	..			227	7	6
Ditto,	ditto			1849-50	..	..	..			193	3	6
Ditto,	ditto			1850-51	..	..	..			175	4	7
Ditto,	ditto			1851-52	..	..	..			.....		
Ditto,	ditto			1852-53	..	..	..			.....		
										1,318	3	7
Removing cudjans, &c. from the houses in Native Town, for the year				1845-46	..	..	..	..	Rs.	46	15	0
Ditto and miscellaneous	ditto			1846-47	..	..				151	4	8
Ditto	ditto	ditto		1847-48	..	..				82	10	0
Ditto	ditto	ditto		1848-49	..	..				67	15	9
Ditto	ditto	ditto		1849-50	..	..				111	8	0
Ditto	ditto	different	ditto	1850-51	..	..				158	2	0
Ditto	ditto	ditto		1851-52	..	..				598	11	2
Ditto	ditto	ditto		1852-53	..	..				720	1	2
										1,937	3	9
										Carried over..	18,69,893	4	6

							Rs.	a.	p.
				Brought over..			18,69,893	4	6
Work done departmentally, for the year			1845-46* ..	Rs.	652	6 0			
Ditto	ditto,	ditto	1846-47 ..		....				
Ditto	ditto,	ditto	1847-48 ..		558	1 11			
Ditto	ditto,	ditto	1848-49 ..		2,020	9 5			
Ditto	ditto,	ditto	1849-50 ..		2,529	4 1			
Ditto	ditto,	ditto	1850-51 ..		2,931	10 0			
Ditto	ditto,	ditto	1851-52 ..		252	0 0			
Ditto	ditto,	ditto	1852-53 ..		231	0 0			
							9,174	9	5
				Total....		Rs.	18,79,067	13	11

2ND.

Mode in which such Works are let to Contract.

The plans and estimates of all new works are in the first instance approved by the Board and Bench, and forwarded to Government for sanction. On the sanction of Government being received, an advertisement is inserted in the *Government Gazette*, to the effect that verbal tenders for their execution will be received, on the day and hour specified, at the office of the Superintendent of Repairs, where the plans and estimates will remain for public inspection during the interim.

At the time fixed, there is generally an attendance of about 20 contractors. The work is then put to Dutch auction, at the amount of the engineer's estimate, and is ultimately knocked down to the lowest bidder. The names of all the competing parties, and the amount of the three lowest tenders, is taken down in the office records, a copy of such record (in the annexed form) being forwarded to the Board, with a recommendation that the contract should be given to the lowest bidder (if unobjectionable,) and on the confirmation of the Board being received the work is commenced.

* For particulars of the works done departmentally, see Appendix A of the Board's Report to Government for 1845-46 (*Government Gazette*, 11th August 1846); Appendix A of similar Report for 1847-48 (*Government Gazette*, 19th September 1848); Appendix A of similar Report for 1848-49 (*Government Gazette*, 18th October 1849); Appendix F of similar Report for 1849-50 (*Government Gazette*, 19th September 1850); Appendix E of ditto for 1850-51 (*Government Gazette*, 13th November 1851); Appendix F of ditto for 1851-52 (*Government Gazette*, 5th May 1853); Appendix F of ditto for 1852-53 (*Government Gazette*, 25th May 1854).

Rates at which they are estimated, and have been executed.

Works sold in Superintendent of Repairs' Office on the 15th February 1851. (Form of Office Contract Register.)

Date of Sale.	Names of the Contractors present.	Description of Works.	Amount of Estimates, without Contingencies.	Amount of lowest Tenders.	Names of three lowest Bidders.	To be completed by
			Rs. a. p.	*Rs. a. p.*		
1851 Feb. 15.	Jamsetjee Dorabjee; Bomanjee Jamsetjee; Martund Bajee; Sorabjee Cursetjee; Pestonjee Rustomjee; Jehangeer Kakhusroo; Rustomjee Ruttonjee; Rutton Khan; Jairam Yadowjee; Gungaram Ramjee; Ragoo Woodajee; Dhondoo Wittul; Pandoo Sumbajee; Madoo Hurjee; Tookaram Hurjee; Bappoo Asmoodin; Nillajee Pootlajee; Pestonjee Pallonjee; Govind Callojee; Cursetjee Rustomjee; Angud Purduchee; Shaik Babun; Hookajee Ningoo; Dhondoo Narrayen; Babajee Ramjee; Elsette Nursoo; Sayajee Goonajee.	Opening a road from Bhooleshwur Road to Parell Road through the Pinjrapole (advertised in the *Government Gazette* of the 13th February 1851, page 235).	2,636 0 4	1,175 0 0 1,200 0 0 1,225 0 0	Dhondoo Wittul and Ramjee Dajeeba. Gungaram. Ramjee Dajeeba.	31st May 1851.
		Making masonry covered drains on both sides in Ardaseer Dady Street (advertised in the *Government Gazette* of the 13th February 1851, page 235).	3,032 0 9	1,375 0 0 1,400 0 0 1,425 0 0	Gungaram Ramjee. Tookaram Hurjee. Gungaram Ramjee.	30th April 1851.
		Sinking and building a well, with platform, at Gowalla Tank.	2,307 10 7	1,250 0 0 1,300 0 0 1,325 0 0	Dhondoo Narrayen. Jamsetjee Dorabjee. Bomanjee Jamsetjee.	15th April 1851.

Schedule of Railway Contract Rates.

Items.	Contract No. 1. From Bombay to Tanna. (Messrs. Faviell and Fowler.)			Contract No. 2. Line from Chendanee to Perseek Point. (Mr. J. Jackson.)			Contract No. 3. From Perseek Point to Callian. (Jamsetjee Dorabjee.)			Contract No. 4. Line from Callian to Wasindree. (Jamsetjee Dorabjee.)		
	£	s.	d.	£	s.	d.	Rs.	a.	p.	Rs.	a.	p.
Average price of earthwork deposited in embankment, per cubic yard..	0	0	8¼	0	0	9½	0	4	6	0	6	6
Earthwork deposited in embankment No. 1, per cubic yard	.....			0	1	4	.....			.....		
Earthwork deposited in embankment, when the length of lead does exceed ¼ of a mile, per cubic yard	0	0	10	0	0	9½	0	4	0	0	4	0
Ditto ditto ½ ditto ditto ditto ditto ..	0	1	0	0	0	11½	0	6	0	0	6	0
Ditto ditto ¾ ditto ditto ditto ditto ..	0	1	4	0	1	1½	0	8	0	0	8	0
Ditto ditto 1 ditto ditto ditto ditto ..	0	1	8	0	1	3½	0	10	0	0	10	0
Ditto ditto 1¼ ditto ditto ditto ditto ..	0	2	0	0	1	5½	0	11	0	0	11	0
Ditto ditto 1½ ditto ditto ditto ditto ..	0	2	0	0	1	7½	0	12	0	0	13	0
Ditto ditto 1¾ ditto ditto ditto ditto ..	0	2	4	0	1	9½	0	13	0	0	13	0
Ditto ditto 2 ditto ditto ditto ditto ..	0	2	6	0	1	11½	0	14	0	0	14	0
For every additional quarter of a mile, ditto	0	0	4	0	0	2	.....			.....		
Earthwork deposited in embankment from rock cutting, when the length of lead does not exceed ¼ of a mile, per cubic yard . ..	.....			.....			0	5	0	0	5	0
Ditto ditto ½ ditto ditto ditto ditto ..	.....			.....			0	7	6	0	7	6
Ditto ditto ¾ ditto ditto ditto ditto ..	.....			.....			0	10	0	0	10	0

Items.	Contract No. 1. From Bombay to Tanna. (Messrs. Faviell and Fowler.)			Contract No. 2. Line from Chendanee to Perseek Point. (Mr. J. Jackson.)			Contract No. 3. From Perseek Point to Callian. (Jamsetjee Dorabjee.)			Contract No. 4. Line from Callian to Wasindree. (Jamsetjee Dorabjee.)		
	£	s.	d.	£	s.	d.	Rs.	a.	p.	Rs.	a.	p.
Earthwork deposited in embankment from rock cutting, when the length of lead does not exceed 1 mile, per cubic yard	.....			.....			0	12	6	0	12	6
Ditto ditto 1¼ ditto ditto ditto ditto	.....			.....			0	13	9	0	13	9
Ditto ditto 1½ ditto ditto ditto ditto	.....			.....			0	15	0	0	15	0
Ditto ditto 1¾ ditto ditto ditto ditto	.....			.....			1	0	3	1	3	0
Ditto ditto 2 ditto ditto ditto ditto	.....			.....			1	1	6	1	6	0
For every additional quarter of a mile, ditto	.....			.....			0	1	0	0	2	0
Side-cutting lead, not exceeding 100 yards, ditto	0	0	9	0	0	9	0	4	0	0	6	0
Side-cutting from trenches, ditto	.....			.....			0	5	0	0	5	0
Trimming slopes of cuttings and embankments, per square yard	0	0	0¾	0	0	0¾	0	0	4	0	1	0
Stone-pitching on slopes, 12 inches thick, ditto	0	6	0	0	1	0	0	5	0	0	8	0
Soiling slopes	0	0	0¾	0	0	0¾	0	0	4	.....		
Stone-pitching in inverts, 12 inches thick, per square yard	.....			.....			1	0	0	1	0	0
Excavation of foundations of bridges and culvert in rock, per cubic yard	.....			.....			.....			3	0	0
Ditto ditto ditto in moorum, ditto	0	0	9	0	0	9	0	6	0	0	12	0
Concrete	0	10	0	0	6	0	2	4	0	2	8	0
Brickwork in piers, abutments, &c. per cubic yard	0	13	0	0	16	0	6	0	0	7	8	0
Ditto in arch in viaduct, ditto	.....			.....			.....			15	0	0
Ditto ditto in bridges, ditto	0	16	0	1	0	0	7	8	0	12	0	0
Ditto in culverts, ditto	0	15	0	.....			7	8	0	10	0	0
Block in course masonry, ditto	.....			.....			8	0	0	14	0	0
Coursed rubble masonry, ditto	.....			.....			.....			10	0	0
Rubble masonry in bridges, ditto	.....			.....			6	0	0	7	0	0
Rubble masonry in walling and blocking, ditto	0	12	0	0	10	0	4	0	0	7	0	0
Rubble masonry, with block and course page work, in piers, abutments, &c. of blocking course, per cubic yard	1	2	0	0	18	0	.....			.....		

Dry rubble walling, ditto	0	8	0	0	6	6	2	12	0	5	0	0
Ashlar in string course, &c. per cubic foot	0	2	6	0	2	0	0	14	0	1	4	0
Ashlar springers and arch quoins, ditto..		.....			.....		13	0	0	1	4	0
Post and rail fencing, fixed, complete, per lineal yard..	0	2	0	0	1	0	11	3	0	0	11	0
Prickly-pear fencing, and mound	0	0	3	0	0	2	0	0	9	0	1	0
Wrought-iron in bolts, washers, per cwt.	2	0	0	2	0	0	19	0	0	20	0	0
Pile-driving, including rings and shoes, per lineal foot..	0	2	0	0	2	0	0	14	0	1	0	0
Timber for piles, 15 feet long, per cubic foot	0	3	6	0	2	6	1	0	0	2	0	0
Ditto 20 ditto ditto	0	3	9	0	3	0	1	4	0	2	0	0
Southern teak, in girders, joists, &c. per cubic foot	0	4	6	0	4	6	2	0	0	2	8	0
Ditto, 3-inch planking, per square foot	0	5	0	0	4	0	2	0	0	0	10	0
Khair, in blocks, joists, posts, &c. ditto	0	3	0	0	3	0	1	0	0	1	0	0
One pair of gates, with posts, set, complete, including the coats of paint, as per specification and drawing, for 15 feet roadway ..	20	0	0	20	0	0	150	0	0	130	0	0
One pair of gates, 20 feet roadway	50	0	0	40	0	0	275	0	0	200	0	0
Ditto ditto, 30 ditto	100	0	0	45	0	0		.....			.....	
Wicket gate, set, complete	5	0	0	3	0	0	50	0	0	50	0	0
Metalling for road, 9 inches thick, per square yard	0	2	6	0	1	0	0	8	0	0	8	0
Clay puddle for bridges, per cubic yard	0	2	6	0	1	6	0	12	0	0	12	0
Ballast for permanent road, provided and spread, per ditto	0	1	2	0	1	9	0	10	0	0	10	0
Ditto ditto on siding and stations	0	2	3		.....			.....			.....	
Laying single line of permanent way, including keys, per lineal yard..		.....		0	1	9	1	0	0	1	4	0
Ditto double ditto ditto ditto ..	0	4	0		.....			.....			.....	
Laying a single crossing, per ditto	0	5	0	0	5	0	2	4	0	2	4	0
Cast-iron girders, fixed, complete	..	...		12	0	0		.....			.....	
Laying one set of points, ditto	0	6	0		.....		2	0	0	2	0	0
Ditto ditto, each		.....		2	10	0		.....			.....	
Laying a complete through crossing, per lineal yard	0	6	0	0	5	0	2	4	0	2	4	0
Keys, per 1000	10	0	0	8	0	0		.....			.....	
Loading rails, chairs, pins, and other materials, including loading and unloading, per ton per mile	0	1	0	0	1	0		.....			.....	
Loading sleepers, per 100 per mile	0	5	0	0	10	0		.....			.....	
Wages.												
Wages for excavators, per day	0	1	4	0	0	8	0	4	0	0	3	0
Bricklayers, ditto	0	8	0	0	1	3	0	8	0	0	8	0

Items.	Contract No. 1. From Bombay to Tanna. (Messrs. Faviell and Fowler.)			Contract No. 2. Line from Chendanee to Perseek Point. (Mr. J. Jackson.)			Contract No. 3. From Perseek Point to Callian. (Jamsetjee Dorabjee.)			Contract No. 4. Line from Callian to Wasindree. (Jamsetjee Dorabjee.)		
	£	s.	d.	£	s.	d.	Rs.	a.	p.	Rs.	a.	p.
Masons, per day	0	2	6	0	1	3	0	10	0	0	8	0
Carpenters, ditto	0	3	0	0	1	3	0	8	0	0	10	0
Smiths, ditto	0	3	6	0	1	6	0	12	0	1	0	0
Plate-layers (Europeans), per day	0	7	0	0	6	0	5	0	0	8	0	0
Labourers, ditto	0	1	0	0	0	8	0	3	0	0	3	0
Cart and pair of bullocks, ditto	0	2	0	0	2	0	1	0	0	1	0	0
12-inch drain, per lineal yard	0	7	0	0	8	0	2	0	0	3	0	0
18-inch ditto, ditto	0	8	0	0	10	0	3	0	0	5	0	0
24-inch ditto, ditto	0	10	0	0	15	0	4	14	0	8	0	0
30-inch ditto, ditto	0	18	0	1	1	0	8	0	0	12	0	0
3-feet culvert, ditto	2	10	0	1	10	0	15	0	0	15	0	0
4-feet ditto, ditto	4	0	0	3	3	0	.....			.....		
6-feet ditto, ditto	8	0	0	6	10	0	40	0	0	30	0	0
Double 2-feet culvert, ditto	1	10	0	1	10	0	15	0	0	20	0	0
Ditto 2-feet 6-inch do. ditto	2	10	0	1	17	6	18	12	0	20	0	0
Treble 2-feet 6-inch do. ditto	.....			.....			.....			30	0	0
Double 4-feet culvert, ditto	9	0	0	6	0	0	60	0	0	70	0	0
Paving at lineal crossing, per square yard	0	5	0	0	5	0	2	0	0	3	0	0
Painting (3 coats), ditto	0	1	0	0	1	0	0	6	0	0	10	0
Tarring (2 coats), ditto	0	0	9	0	0	6	0	3	0	0	8	0
Dammer (2 coats), ditto	0	0	9	0	0	9	0	5	0	0	6	0
Adzing sleepers, per 100	0	18	0	0	10	0	.....			.....		
Cost of occupation level crossing (as per schedule of quantities), each	.....			15	0	0	125	0	0	150	0	0
Rubble boundary wall (Drawing No. 13), per cubic yard	0	14	0	.....			.....			.....		
Palisade fencing (Drawing No. 13), per lineal yard	0	5	0	.....			.....			.....		

Office Rates of the Superintendent of Repairs' Department.

Principal Descriptions of Works executed by the Superintendent of Repairs' Department.	No. 1. Office Estimated Rate per 100 cubic feet.
	Rs. a. p.
Excavation for foundation or for drains, in earth	0 8 0
Ditto ditto ditto, in soft moorum	0 12 0
Ditto ditto ditto, in hardditto	2 0 0
Ditto ditto ditto, in soft rock	3 0 0
Ditto ditto ditto, in solid ditto	6 0 0
Filling in foundation with rubble masonry	10 0 0
Rubble masonry superstructure, under 10 feet high	11 0 0
Block in course, with rubble masonry backing, like Byculla and Mazagon railway bridges	35 0 0
Cut-stone facing, middle dressed, per 100 square feet	44 0 0
Brick arching, exclusive of centering	27 0 0
Ditto with mud centering	30 0 0
Plastering, chunam, per 100 square feet	4 8 0
Ditto polished, and on curvilinear surface	6 0 0
Coping stone, rough dressed, per cubic foot	0 10 0
Slab-stones for covering small drains, 2 feet by 1 foot, by 5 inches thick, each	0 5 0
Ditto ditto ditto, 3 feet by 1 foot, by 5 inches thick, each	0 8 0
Ditto ditto ditto, 4 feet by 1 foot, by 5 inches thick, each	0 12 0
Pavement Porebunder stone on rubble masonry, 1 foot thick, per 100 square feet	30 0 0
Ditto blue stone, rough dressed, in rubble masonry foundation	1 8 0
Ditto ditto, middle dressed	2 3 0
Ditto chunam terrace floor	9 0 0
Road-making.	
Raising embankment up to the height of 5 feet from side cutting	0 10 4
Ditto ditto, to ditto within ¼ mile lead	0 15 0
Dry stone retaining wall	2 6 0
Raising and levelling ground for roadway of not more than a foot in mean height	1 0 0
Khandkies, hammer dressed, for kerbstone, 1 foot square, 1¼ feet long, per 100 khandkies	13 0 0
Rough stone kerbstone (undressed)	6 0 0
Paved side water-table for town roads, 1 foot wide, per 100 running feet	20 0 0
Slabstone for sink, 2 by 1¼, perforated with 5 holes	1 8 0
Broken stone, for metalling 1½ inches thick, per 100 square feet, laying and rolling included	0 12 6
Ditto ditto 2 inches ditto ditto ditto	1 0 9
Ditto ditto 3 ditto ditto ditto ditto	1 9 0
Ditto ditto 4 ditto ditto ditto ditto	2 1 3
Ditto ditto 6 ditto ditto ditto ditto	3 2 0
Sand-stone, ½ inch thick, laying and rolling, per 100 square feet	0 12 0
Ditto 1 inch thick, ditto ditto ditto	1 0 0

Rates of the Estimate, and of the lowest Tenders for the filling in of Mody Bay, on the Sea-face of the Fort of Bombay.

[The work consisted of a Sea-wall about 22 feet in height, and filling in behind; the total estimated cost being about £ 70,000.]

(Garrison Engineer and Civil Architect.)

Items.	Quantity.	Rate.			Per	Amount.		
		Rs.	*a.*	*p.*		*Rs.*	*a.*	*p.*
Excavation for foundation of sea-wall within, at, or nearly at low-water mark.....	163,532	2	0	0	100 cub. ft.	3,270	10	0
Rubble masonry in foundation of sea-wall	142,817	19	0	0	Do.	27,135	3	8
Khandkee facing in foundation of sea-wall	12,435	50	0	0	100 sq. ft.	6,217	8	0
Squared stone-cap of foundation of sea-wall	4,145	200	0	0	100 rg. ft.	8,290	0	0
Rubble masonry in sea-wall	465,632	19	0	0	100 cub. ft.	88,470	12	3
Khandkee facing in sea-wall....	81,539	75	0	0	100 sq. ft.	61,154	4	0
Dove-tailed coping stone of the sea-wall	4,145	275	0	0	100 rg. ft.	11,398	12	0
Rubble masonry in walls at any spot within the sea-wall.....	74,974	16	0	0	100 cub. ft.	11,995	13	5
Brick masonry arch-work	9,761	30	0	0	Do.	2,928	4	9
Chunam plaster, $\frac{3}{4}$ inch thick.....	3,397	4	8	0	100 sq. ft.	152	0	0
Filling in of sand or earth.....	24,013,613	2	8	0	100 cub. ft.	6,00,340	5	2
Total.....	.....	.....			..... Rs.	8,21,354	7	3

(PEERKHAN LANDKHAN and SAYBOO NURSOO.)

Items.	Quantity.	Rate.			Per	Amount.		
		Rs.	*a.*	*p.*		*Rs.*	*a.*	*p.*
Excavation for foundation of sea-wall within, at, or nearly at low-water mark...	163,532	1	14	0	100 cub. ft.	3,066	3	7
Rubble masonry in foundation of sea-wall	142,817	17	0	0	Do.	24,278	14	2
Khandkee facing in foundation of sea-wall	12,435	48	0	0	100 sq. ft.	5,968	12	9
Squared stone-cap of foundation of sea-wall	4,145	175	0	0	100 rg. ft.	7,253	12	0
Rubble masonry in sea-wall	465,632	17	0	0	100 cub. ft.	79,157	7	0
Khandkee facing in sea-wall.....	81,539	65	0	0	100 sq. ft.	53,000	0	0
Dove-tailed coping stone of the sea-wall	4,145	250	0	0	100 rg. ft.	10,362	8	0
Rubble masonry in walls at any spot within the sea-wall..... ...	74,974	15	0	0	100 cub. ft.	11,246	1	7
Brick masonry arch-work	9,761	28	0	0	Do.	2,733	1	3
Chunam plaster, $\frac{3}{4}$ inch thick.....	3,397	4	4	0	100 sq. ft.	144	5	11
Filling in of sand or earth.....	24,013,613	2	2	0	100 cub. ft.	5,10,289	4	5
Total.....	.....	.....			..... Rs.	7,07,500	0	0

(ELSETTE NURSOO and RAJUNNA CRUSTNAJEE.

Items.	Quantity.	Rate.			Per	Amount.		
		Rs.	*a.*	*p.*		*Rs.*	*a.*	*p.*
Excavation for foundation of sea-wall within, at, or nearly at low-water mark	163,532	2	4	0	100 cub. ft.	3,679	7	6
Rubble masonry in foundation of sea-wall	142,817	15	0	0	Do.	21,422	8	9
Khandkee facing in foundation of sea-wall	12,435	45	8	0	100 sq. ft.	5,657	14	9
Squared stone-cap of foundation of sea-wall	4,145	180	0	0	100 rg. ft.	7,461	0	0
Rubble masonry in sea-wall	465,632	17	0	0	100 cub. ft.	79,157	7	0
Khandkee facing in sea-wall.....	81,539	70	0	0	100 sq. ft.	57,077	4	9
Dove-tailed coping stone of the sea-wall	4,145	260	0	0	100 rg. ft.	10,777	0	0
Rubble masonry in walls at any spot within the sea-wall.....	74,974	14	0	0	100 cub. ft.	10,496	5	9
Brick masonry arch-work	9,761	32	0	0	Do.	3,123	8	3
Chunam plaster, $\frac{3}{4}$ inch thick ...	3,397	5	0	0	100 sq. ft.	169	13	7
Filling in of sand or earth.....	24,013,613	2	2	0	100 cub. ft.	5,10,289	4	5
Total.....	.....	.....			..... Rs.	7,09,311	10	9

(Signed) J. J. F. CRUICKSHANK, Captain,
Garrison Engineer, and Civil Architect, Presidency.

FINANCIAL DEPARTMENT (*Railway Branch*),
Garrison Engineer and Civil Architect's Office,
Bombay, 10*th March* 1854.

Rates at which Bungalows are constructed on Malabar Hill.

Foundation digging	Rs.	0 10 0	per 100 cub. ft.	
Ditto filling in with material, and labour inclusive		1 0 0	„	„
Ditto ditto ditto, with stone close by		12 0 0	„	„
Ditto ditto ditto, if stone from a distance.		13 0 0	„	„
Off-set wall above foundation		13 0 0	„	„
Filling in with earth and stone		1 0 0	„	„
Wall, with material, including labour, for bungalow, with plaster in and out		18 0 0	„	„
Ditto ditto ditto, for offices ditto		15 0 0	„	„
Plastering outside of the veranda off-set wall		3 0 0	„	sq. ft.
Flooring with chunam rough terrace		10 0 0	„	„
Teakwood doors for bungalow		1 4 0	per square foot.	
Ditto windows ditto		1 12 0	„	„
Jungle-wood doors and windows		0 12 0	„	„
Roofing for bungalow, with teak trusses, jungle round rafters, and ceiling, complete		65 0 0	per 100 sq. ft.	
Ditto for veranda with posts, putties, sawn, jungle rafters and battens, tiled complete		35 0 0	„	„
Ditto for offices		35 0 0	„	„

Rates at which the Byculla Club Chambers were constructed.

Excavation foundation of main wall	Rs.	1 0 0	per 100 cub. ft.	
Filling in foundation with stone and lime		10 0 0	„	„
Plinth of masonry walls		10 0 0	„	„
Stone and lime masonry walls		15 0 0	„	„
Brick partition, exclusive of plaster		30 0 0	„	sq. ft.
Plank partition, deducting doors		0 5 0	„	„
Roof, teak, double tiled, matted round, teak rafters, cut teak battens, with teak plank ceiling and cornice		70 0 0	„	„
Ground floor, terraced		12 0 0	„	„
Teak plank floors, with aynee jungle joists		40 0 0	„	„
Teak rails for staircases and gallery		0 8 0	per running foot.	
Cornice to gallery		1 0 0	„	„
Cloth ceiling, including teak cornice		12 0 0	per 100 rg. ft.	
Plank ceiling		20 0 0	„	„
Masonry drain, covered, $1\frac{1}{4} \times 1\frac{1}{4}$		1 0 0	per running foot.	
Teak posts		2 8 0	per cubic foot.	
Chunam plaster, and green and white wash		5 4 0	per 100 sq. ft.	
Teak plank doors, $3 \times 6\frac{1}{2}$		15 0 0	each.	
Ditto windows, with teak bars, $3\frac{1}{2} \times 6$		21 0 0	„	
Fixed venetians to galleries, 8×7		63 0 0	„	

Teak venetianed doors, 8 × 8	Rs.	80	0	0	each.
Ditto ditto, 4 × 7		42	0	0	„
Teak pannelled doors, 2 × 6½		16	0	0	„
Teak venetianed doors, 3 × 7		30	0	0	„
Bathing-room and pannelled doors, 2½ × 6½		18	0	0	„
Teak trellis windows, 16½ × 3		24	0	0	„
Teak folding venetianed windows, 4 × 7		42	0	0	„
Ditto ditto ditto, 4 × 6		36	0	0	„
Passage lattice-work		0	2	0	per foot.
Green wash to cloth ceiling		1	4	0	per 100 sq. ft.
Green paint, two coatings, and varnished		6	0	0	„ „

APPENDIX G.

Rough Estimate of the probable Cost of certain Public Improvements urgently and immediately required for the improvement of the Island.

Names of the Streets.	Length in Feet.	Rate per Foot.	Amount.
			Rupees.
Esplanade Cross-road, from Shaik Memon Street to Slaughter House (one side)	1,995	4	7,980
Parell Road, from Jugjeevan Keeka Street to Byculla ..	4,270	7	29,890
Breachcandy Road, from Agiary Road to Portuguese Church Lane	3,860	5	19,300
Road from Portuguese Church to Chowpatty Road ..	2,000	5	10,000
Agiary Road	1,550	6	9,300
Cowasjee Patel Tank Road	990	5	4,950
Duncan Road	3,750	6	22,500
Obelisk Road	1,159	4	4,636
Erskine Road	1,280	4	5,120
Bhooleshwur Road, from Cowasjee Patel Tank to Sunkersett's garden-house...	6,330	8	50,640
Girgaum Portuguese Church Lane	800	4	3,200
Portuguese Church Lane, between Agiary Road and Bhooleshwur Road	750	8	6,000
Bellasis Junction Road	1,650	8	13,200
Erskine Road footpath	1,280	4	5,120
Khetwady Road	3,085	6	18,511
Jail Road	920	8	7,360
Musjeed Bunder Road	1,900	8	15,200
Chinch Bunder Road	2,700	8	21,600
Mazagon Road	2,850	6	17,100
Round the Moombadavee Tank	900	10	9,000
Baboola Tank Road	1,950	6	11,700
Nagdew Street	900	10	9,000
Musjeed Bunder Row	900	10	9,000
Shaik Ally Jungeerkur Street	1,820	8	14,560
Chinch Bunder Sea Road	500	6	3,000
Kolee Bunder Sea Road	73	6	438
Chinch Bunder 1st Row	463	8	3,704
Jamboolwadee Road	260	5	1,300
New Line Street	380	8	3,040
Carried over...	51,265	...	3,36,349

Names of the Streets.	Length in Feet.	Rate per Foot.	Amount.
			Rupees.
Brought over..	51,265	...	3,36,349
Cross-road from Banian Tree Chowkee to Girgaum Road.	440	5	2,200
Burrows Lane	513	5	2,565
Shaik Abdool Doctor Street	1,490	6	8,940
Cammattee Poora Road	10,576	5	52,880
Hoozra Street	1,044	6	6,264
Funuswadee Lane	1,182	6	7,092
Moorbbat Lane...	700	6	4,200
Kakudwadee Lane	380	6	2,280
Road south side of Jail	770	8	6,160
Road north side of Jail	755	6	4,530
Mazagon Road to Dockyard	2,550	6	15,300
Nagdew Row	400	6	2,400
Second Dontarr Row	1,468	8	11,744
Old Cazee Street	513	8	4,104
Shamjee Hassajee Street...	462	8	3,696
Bhundaree Street...	204	8	1,632
Hunuman Road	1,140	6	6,840
Mazagon Lane	1,080	7	7,560
Coppersmith Street, Beebee Jan Row	619	6	3,714
Memonwada Street	1,790	8	14,320
Three cross-streets	450	6	2,700
Road in rear of Mr. Romer's to sea grove	3,920	6	23,520
Poydowney Road...	802	6	4,812
Balloo Surung Street	976	6	5,856
Branch Roads	664	8	5,312
Nishandar Oomercarry Row	472	8	3,776
Branchways	449	8	3,592
Dontarr, 1st Row...	1,137	6	6,822
Old Nagpada Lane	696	6	4,170
New Hunuman Lane	1,135	6	6,810
Dongree Cooly Sea Road...	322	8	2,576
Mahomed Hoossen Kambakur Street	650	7	4,550
Branch road, 2nd Dontarr Row	425	7	2,975
Foogla Street	795	8	6,360
Shamjee Hassajee Street	948	8	7,584
Koombharwada and Bhajee Palla...	1,460	8	11,680
Bhajee Palla Street	377	8	3,016
Continuation of Khetwady Road...	1,105	6	6,630
Ditto of Memonwada Street	395	6	2,370
Ditto of the other branch way from Nishandar Oomercarry to Dontarr 2nd Row	396	6	2,370
Ditto of Nishandar Oomercarry Row	915	6	5,490
Cazee Syed Street, Bhundarwada, and Jamlee Musjeed Street	994	8	7,952
Khoja Street	1,651	6	9,906
Baba Dubboo Street	1,419	6	8,514
Mukoond Guzersett Street	1,077	6	6,462
Goolam Moideen Subedar Street	987	6	5,922
Koombharwara Road in the New Town...	1,488	4	5,952
Carried over..	105,446	...	6,72,449

Names of the Streets.	Length in Feet.	Rate per Foot.	Amount.
			Rupees.
Brought over..	105,446	...	6,72,449
Cross-street connecting Khoja and Shaik Abdool Doctor Street	359	5	1,795
Baboola Tank Lane	595	5	2,975
Agiary and Dhunjee Dongeria Streets	1,439	4	5,756
Churney Road	865	4	3,460
Lawrence de Lima Street...	1,440	5	7,200
Street from Dhobee's Tank to New Sonapoor Road .	1,422	5	7,110
Footpaths on each side of the Obelisk Road	1,159	4	4,636
Tank Street	1,546	5	7,730
Shaik Boorun Commodan Street	715	5	3,575
Road from Chinch Bunder Chowkee to Chinch Bunder Sea Road	525	5	2,625
Thakoordwar Lane	1,446	4	5,784
Road from Khetwady to Grant Road	823	4	3,292
Chinch Bunder Sea Road to Waree Bunder	2,573	6	15,438
Churney Road near Thakoordwar Road, from Breach-candy Road to Old Distillery Street	925 282	6 4	5,550 1,128
Candawady Lane...	1,900	6	11,400
Road from Old Distillery Street to Sonapoor	413	7	2,891
Cross-road from the Native General Hospital to the Sonapoor Drain	375	7	2,625
Khadup Street	825	8	6,600
Dongree Joao Souza Street	958	6	5,748
Hussun Khan Khalifa Row	426	6	2,556
Chinch Bunder 2nd Row...	852	6	5,112
Oomercarry Row...	860	8	6,880
Eduljee Cooper Street	408	5	2,040
Total..	1,28,577	...	7,96,355

APPENDIX H.

A Comparison between the different Methods of conveying away, and ultimately disposing of Night-Soil, adopted in London, Paris, and Bombay; with Suggestions for Obviating the Nuisance arising from the present defective state of the Board of Conservancy's Arrangements for the purpose; together with Suggestions for the proper Regulation of the Bombay Burial Grounds.

1. The nuisance occasioned by the carting away of night-soil along the public streets, and also that arising from the covered cesspools on the Flats into which these carts are emptied, has been (and not without reason) much complained of in Bombay. We are not, however, worse off than other large towns in this respect: the evil exists to at least an equal extent in Paris and London, and an efficient remedy has yet to be devised.

2. I believe the idea generally prevails, that in well sewered towns, the solid (as well as the liquid) excrementitious products of the population are carried off by the drains, and that the evils and nuisances inseparable from the use of such appliances as cesspools and night-carts are thereby avoidable. This is unfortunately not the case. London is considered the best drained city in the world, and contains upwards of 500 miles of sewers; yet the Metropolitan Sanitary Commissioners (in their third report) state the number of cesspools in London at 300,000, or rather more than the number of houses; and they remark that there is reason for believing this to be an under-estimate. These cesspools are rendered unavoidable, by the circumstance of drains being unable to carry away solid matter, unless some mechanical contrivance is adopted by which such solid matter is accompanied by a sufficient volume of water to carry it off: thus none but water-closets are allowed to communicate with sewers; and in all other places of the sort the cesspool is the immediate receptacle.

3. The Metropolitan Sanitary Commissioners calculate the average contents of each of the 300,000 cesspools of London at 58½ cubic feet, and the exhaling surface of each at 9 feet: this gives a total for the Metropolis of 2,700,000 square feet of exhaling cesspool surface, and 17,500,000 cubic feet of ordure.

4. These cesspools are emptied periodically, and their contents

carted away by nightmen, and sold as manure to the farmers in the neighbourhood of London; a large proportion of the cesspools are also used as ash-pits, and whenever this is the case, the nuisance arising from the night-soil is considerably palliated (ashes having the effect of absorbing many of the products of decomposition), and the substance is also solidified, and rendered more convenient for carting away.

5. The importance of getting rid of these cesspools has long been acknowledged, but no practicable scheme has yet been devised for accomplishing the end. It has been proposed that an Act of legislation should be passed, enforcing the universal substitution of water-closets for cesspools, but there are difficulties in the way of such a measure that seem insuperable: in the 1*st* place, it would involve a considerable increase in the consumption of water, and a large consequent expenditure in laying down water-pipes; 2*ndly*, it could not be safely adopted without providing, as a preliminary measure, a perfect system of tubular house-drainage to carry off the increased consumption of water; 3*rdly*, were these difficulties overcome, it is admitted that the Thames could not possibly be any further polluted by being made the receptacle of so vast an additional amount of ordure.

6. To obviate this objection, it has been proposed to make a deep tunnel along each bank of the Thames, parallel to the course of that river, and at a lower level. All the existing sewers would be made to discharge themselves into these tunnels, which would carry the whole sewerage of the Metropolis to deep reservoirs (several miles out of town), where it was to be raised by steam power, and converted by certain chemical processes into an inodorous manure. The project has long been before Parliament; a company was at one time formed for working it, and the engineering advisers of the metropolitan authorities strongly urged its advantages. The expectations, however, held out regarding the remunerative nature of the project as a speculation, are now generally deemed fallacious, and there is but little chance of the project ever getting beyond the blue book stage of proposed improvements. The present cesspool system of London is therefore not very likely to be superseded by any other, although the extension of tubular house-drainage will doubtless have the effect of somewhat diminishing the number of cesspools, and increasing the proportion of water-closets. The system obtaining in other English towns generally coincides with that in force in London.

7. It appears from the foregoing, that the sole advantage of the English system over that obtaining in this island is the circumstance of the London nightmen practising their calling by night only, and that in all other respects the advantage is greatly on the side of Bombay.

8. *Cesspool System in Paris.*—With respect to fœcal refuse, and

much of the house-slops, particularly those of bed-chambers, the cesspool is universally adopted in Paris as the immediate receptacle. Since 1819, the form, size, material, and construction of these cesspools has been stringently regulated by ordinance of Government: a principal object of such enactments being to ensure the cesspools being made water-tight, so that all pollution of the sub-stratum and springs might be prevented, the provisions for the attainment of this object are very strictly enforced by the police. The usual capacity of these cesspools is from 8 to 10 cubic metres (270 to 320 cubic feet). A Paris house has frequently two or three of these, the average of the whole city being one and a half cesspool per house. (It must, however, be borne in mind that the houses in Paris are much larger than those in London, each floor being in fact a complete house).

9. *Mode of Emptying the Cesspools.*—This branch of the subject is one which has exercised a good deal of ingenuity on the part of those who make a commercial speculation of it, and which is also vigilantly attended to by the police authorities.

10. By police regulations, the emptying and carting away can only take place at night. No person is allowed to follow the business of nightman without having previously obtained a license from the Prefect of the Police, which is only granted on proof that he is fully provided with the necessary apparatus. The stock of each of these nightmen is inspected by the police twice a year, when, if found inadequate, or out of repair, his license is withdrawn.

11. The extracting and removal of the contents of cesspools is undertaken by companies, termed *Compagnies de Vidanges.* These are eight in number: that known as the *Compagnie Richer* is the most important, doing more than half the entire work. This company has a capital of upwards of £200,000, invested in the working stock, and employs in its business 350 horses and 120 vehicles of various descriptions. Its principal establishment is at *Mont Faucon*, adjoining the *Voirie*, the spot on which the night-soil of Paris has for ages been deposited.

12. The mode of emptying cesspools adopted universally in Paris is to pump their contents into closed carts for transport. The usual capacity of these carts is 2,000 litres (about 3 tons 8 cwt.), the largest size allowed by police regulation; three horses are employed to draw it.

13. On fixing the rate of charges to the proprietors of houses, Paris has been divided into three districts, by concentric arcs drawn from the Voirie of Mont Faucon as a centre; the charges being respectively 8, 9, and 10 francs per cubic metre. The quantity moved averages from 600 to 700 cubic metres daily, and the sum paid by the inhabitants for its removal exceeds £80,000 per annum.

14. Notwithstanding all possible precautions, the emptying of these cesspools is accompanied by much nuisance, sufficient gas being always evolved to vitiate the surrounding atmosphere to a considerable extent. The cesspools vary considerably in foulness, and it is remarkable that those containing the greatest proportion of water are the most foul and dangerous. This is accounted for by the increased quantity of sulphuretted hydrogen gas evolved; and is more particularly the case where, from their large size, or from the small number of people using them, much time is allowed for the matter to stagnate and decompose in them.

15. The average degree of fluidity of the matter found in the excavated cesspools is what would be produced by the mixture of about one solid part with four of liquid, the solid consisting entirely of fœcal matter, and the liquid being composed of about three parts urine to five of water.

16. *Places of Deposit for the Matter withdrawn from the Cesspools.*—The produce of the cesspools of Paris is from 600 to 700 cubic metres a day (from 21,200 to 24,730 cubic feet). It is nearly all taken to the Voirie of Mont Faucon, where the solid portion is manufactured into a dry manure called *poudrette*. The places of deposit belong to the municipality, who have been in the habit of farming them to the highest bidder for periods of nine years: in 1834 they were let for £7,000 per annum, and in 1843 for £21,000 per annum. I am not aware of the rate of the contract commencing last year. In addition to this, the right of extracting the ammonia (used for smelling-salts and otherwise) from the liquid portion of the ordure is farmed for £3,200 per annum: this farm-rent belongs to the *Fermier General*.

17. The site of the Voirie has undergone extensive excavations for gypsum or Plaster of Paris, and its surface is extremely uneven. The area, which is about 40 acres in extent, is divided into three irregular compartments—1*st*, the system of basins; 2*nd*, the ground used for spreading and drying the matter; 3*rd*, the place where the matter is heaped up after having been dried.

18. The basins, standing for the most part in gradations one above another, by reason of the slope of the ground, are six in number. The two upper ones, which are upon a level, first receive the soil upon its arrival at the Voirie; the four others are receptacles for the more liquid portion as it gradually flows off from the upper basins.

19. The ground used for spreading and drying the matter is in some places flat, in others more or less steep; the latter is most favourable for its easy distribution. It is in the upper basins that the first separation of the liquids and solids takes place, the latter falling to the bottom, and the former gradually flowing off through a sluice into the lower

basin. After lying three or four years, the mass in the upper basins appears like a thick mud, half liquid half solid, and varies from 12 to 15 feet in depth.

20. Deep channels are now cut across the mass, by which the liquids are drained off. When this is completed, the deposit soon becomes sufficiently stiff to permit of its being dug out and spread upon the drying-ground, where, to assist the desiccation, it is turned over two or three times a day by means of a harrow drawn by a horse. Ere it is entirely deprived of humidity, the matter is collected into heaps, which generally remain a twelvemonth untouched, sometimes even for two or three years.

21. When completely dry, the substance is broken up and reduced to powder by women. The *poudrette* then appears like a mould of a grey-black colour, light, greasy to the touch, finely grained, and giving out a peculiar faint and nauseous odour. In general the *poudrette* is dried with great difficulty: *it appears to have an extreme affinity for water—few substances give out moisture more slowly, or absorb it more greedily from the air.* The whole process appears to occupy from four to seven years.

22. The emanations from the Voirie are, as may well be supposed, most powerfully offensive. Large and numerous bubbles of gas are seen constantly and rapidly rising from a lake of urine and water, while evaporation of the most foul description is going on from many acres of surrounding ground, upon which the solid matter is spread out to dry.

23. In perfectly calm weather, these disgusting exhalations spread over a wide area around the Voirie: a fresh breeze will carry them over a distance of many miles, and when blowing from a northerly direction, the foul volume is swept by it entirely across Paris. Under peculiar states of the atmosphere, its presence may be distinguished at the opposite extremity of the city: in the centre, and particularly along the quays, it is at such times most disgustingly apparent, while on the Boulevards, Bonne Nouvelle, St. Martin du Temple, &c. it prevails in intolerable strength—there it penetrates everywhere, pervading the cafes, the theatres, and the houses.

24. M. Parent du Chatelet thus describes this gigantic nuisance in a report to the Council of Health, written in 1833 :—

"The influences of this *Voirie* have necessarily increased with the quantity of matter which has been deposited there. At present the infectious emanations given out from it are insupportable at all seasons within a circumference of 2,000 metres (about 1¼ mile), and the winds carry them sometimes with all their intensity to a distance of 4,000 metres; and evidence collected by the commission charged to ascertain the extent of the ravages of the cholera in the rural communes shows

that certain states of the atmosphere, rarely occurring, it is true, propagate them even to a distance of eight French miles (nearly five English miles). Can it be otherwise while the superficial area of the basins alone is 32,800 metres (39,228 square yards), without including 12 acres occupied by the dry matter and the knackers' yard; and while from 330 to 340 cubic metres of matter withdrawn from the cesspools are daily deposited there, and the larger part of the carcases of 12,000 horses, and of from 25,000 to 30,000 small animals are allowed to rot upon the ground?"

25. The nuisance was found to be so excessive, and people exclaimed so loudly against it, that the Commune of Paris determined many years since to remove the *Voirie* altogether away from the vicinity of the city. With this view, they caused another place of deposit to be formed in the forest of Bondy, about eight miles distant from Paris; but the establishment of these basins was undertaken without any very definite notions as to the mode by which the fœcal matter was to be conveyed to them. A railway was proposed for the purpose, but the idea abandoned, on the ground of expense; the new basins at Bondy are, therefore, scarcely used at all, and the nuisance of the *Voirie* of Mont Faucon continues unabated.

26. The large sum (exceeding two lakhs a year) realized by the Municipality of Paris from the farm of the *Voirie* at Mont Faucon has been often adduced as an instance of the practicability of making the disposal of night-soil a source of municipal revenue in other large towns. I have, however, shown that, while the sum realized by the Municipality of Paris from this source is only £21,000, the cost of the conveyance of the soil to Mont Faucon is £80,000 per annum, or nearly four times as great. It is true that the expense of conveyance has been *hitherto* borne by the owners of cesspools; but the latter have recently claimed a right to the proceeds of the sale; and their claim is indisputably an equitable one, particularly if the nuisance to which they are subjected by the close proximity of the *Voirie* be taken into consideration.

27. The Paris system is about the worst that could be devised. In paragraph 14 I have shown that the admixture of water has the effect of rendering collections of night-soil much more foul and dangerous than they would otherwise be, by increasing the quantity of sulphuretted hydrogen gas evolved. From this it follows that the dry system is always the best with respect to night-soil, and tropical climates offer peculiar facilities to the adoption of a dry system.

28. The Paris system of rendering the cesspool the receptacle of every sort of liquid slop, as well as of soil, is evidently very objectionable in this respect, and by increasing the volume of the offensive

matter emptied into the cesspools, proportionately increases the expense of extracting and conveying away their contents. The time the matter is allowed to ferment in these cesspools (owing to their great size) has also the ill effect of rendering the contents more offensive and dangerous than they would be if more frequently removed.

29. These serious disadvantages are, however, much palliated by the police regulations regarding the construction and emptying of the Paris cesspools, and by the very stringent supervision exercised by the police over the minutest working details of the system in force.

30. The London system is better than that of Paris, as being a drier one. The contents of the London cesspools are generally undiluted with water (all slops and liquid refuse being carried off by the drains). The construction of the London cesspools, and the mode of emptying them, is, however, much less perfect than that enforced at Paris. On the other hand, the gigantic nuisance of the *Voirie* of Mont Faucon has no parallel in England.

31. The principle adopted at Bombay, of removing the night-soil from each individual privy in baskets *daily*, and *without any admixture of liquid*, together with the general non-allowance of cesspools within the town, is open to much fewer sanitary objections than the systems in force at London and Paris.

32. In tropical climates, it might be expected that the facilities for desiccation would be so much greater than in Europe, that some portion of the difficulty experienced in dealing with night-soil in temperate latitudes would be removed. This is, however, only the case where the substance can be dealt with as it is by the Candaharees and the Affghans in minute quantities.

33. These tribes are very sensible of the advantages of the substance as a manure: they expose their night-soil to the sun, spread out in thin cakes on the flat roofs of their houses. Under this treatment, it speedily becomes dry and inoffensive, and is in fact reduced to the state of *poudrette* by a process occupying as few days as the Parisian method occupies years. It is, however, clearly impossible to deal with the excrementitious matter of a large town in the Candaharee method, and when dealt with in large quantities night-soil is as difficult of desiccation at Bombay as at Paris. It has an equal tendency to absorb moisture from the air, and the air contains more moisture to absorb.

34. The Chinese have two methods, a dry and a wet one. In the former they mix the substance, before it becomes fermented, with a rather greater volume of common earth, making the mixture into cakes, which soon become dry and inodorous, and are then sold as manure; their other method is to dilute and mix the substance with a great many volumes of water, using the mixture as a liquid manure, which they

ladle out to the roots of their vegetables. The Mahableshwur potatoes owe their size to being manured in this manner by the Chinese who cultivate them.

35. I have been informed that in Surat the Chinese dry method is followed, but on a larger scale; the sweepers' baskets being emptied into a shallow excavation as evenly as possible, and each day's deposit covered up by a layer of fine sifted earth rather more than equal in quantity to the former. The pit is thus filled up with very thin alternate layers of earth and night-soil, and after laying a few months becomes perfectly dry and inodorous, and is broken up and sold as manure.

36. This plan evidently admits of many modifications, some of them very economical; and were the value of night-soil for agricultural and horticultural purposes sufficiently appreciated, and did no prejudice exist regarding its use, the substance, if prepared for manure in the Surat method, would always command a price which would at least pay the expenses of so preparing it. This, however, would not at present be the case at Bombay.

37. Bombay contains very few private cesspools; they are only allowed in districts where no public drains, either open or covered, have as yet been provided, and even in these instances their use is restricted to the reception of *liquid* sewerage alone—all *solid fœcal refuse* being daily carried away in baskets by the sweepers or nightmen.

38. The mode of disposing of the solid fœcal refuse is as follows:—By regulation, it is enacted that all privies should be situated in the rear of the houses to which they belong; and, with few exceptions, they are so. Access is obtained to them by means of narrow passages called gullies. A single gully sometimes runs along the rear of two rows of houses facing to different streets, but placed back to back, and forming one block, that gully being common to all the houses of both rows: this is the best arrangement. In other cases, gullies running directly from the street to the rear of each house are common only to the two houses which they separate.

39. During the last few years, the gullies have been very generally paved and sloped (mostly at the expense of the inhabitants), under the superintendence of the Surveyor to the Court of Petty Sessions' establishment. In paving them, the centre of the gully is always made lower than their sides, and the whole passage is given a sufficient fall to the nearest public drain.

40. The object of these paved passages is twofold: to convey along a non-absorbent surface the scanty slops and wastage water of the houses to the drains; and also to serve as a passage to the Halalcores or nightmen, who daily carry away in baskets (one of which, partially filled with straw, is expected to be always placed under each privy)

the solid fæcal refuse of the inhabitants. These gullies, when once paved, are daily cleaned by the Bench's Scavenging Contractor, and daily inspected by the peons of the Overseers' department, who report for summons to the overseers of the divisions all parties whose privies are unprovided with baskets, or otherwise in a dirty state, and such offenders are brought before the Court of Petty Sessions, and, on conviction, fined.

41. This is the system in force, and generally observed at Bombay: exceptions and evasions are, however, more numerous than they ought to be, owing to the numerical deficiency of the Overseers' department, and to the inadequacy of existing regulations, and the Court of Petty Sessions.

42. Thus far the system in force at Bombay is decidedly superior to that of either London or Paris; the principle of *daily* carrying the substance away in small *quantities* as fast as it is produced being much better than the London and Paris plan of allowing it to *accumulate for months* in spacious cesspools. Concentration and fermentation are both to be avoided as much as possible in dealing with this substance. I believe that the Bombay system is *thus* far less objectionable than any other plan that could be devised for Bombay; but two things are required—1*st*, that means of enforcing it, more prompt and stringent than those at present available, should be provided; and 2*nd*, that the sweepers or nightmen, like those of Paris and London, should be under the control of the police, and should be registered, and not be allowed to practice their calling except at night.

43. I have already mentioned that the Native Town of Bombay naturally admits of three great physical sub-divisions—1*st*, the Old Town Districts, regularly laid out into streets, and built on a rocky swell facing the harbour; 2*nd*, the Oart Districts, occupying, as the name implies, the site of cocoanut plantations, which *have become* densely and irregularly covered with houses, without having ever been laid out into streets or intended for a town, and built on a gentle swell of littoral concrete or recent sandstone facing Back Bay; and 3*rd*, the New Town Districts, regularly laid out into streets, and built on the low clay ground, generally below high-water mark, that lies between the two swells on which the Old Town Districts and the Oart Districts are built, and *consequently much further removed than either of them from the sea margin.*

44. The sea-beach used formerly to be the only place of ultimate deposit for the contents of the sweepers' baskets; those of the Oart Districts being emptied on the beach at Back Bay, and those of the Old Town, on the harbour sea-beach at Chinch Bunder; but the New Town Districts being much further from the sea than either of the former, the

sweepers employed there frequently emptied their baskets in the first dark corner they could find.

45. In describing these gullies, or Halalcores' passages, I have mentioned that they are *now* generally daily cleaned by the Bench's Scavenging Contractor, and subject to the supervision of the Overseers' establishment: this, however, has only been the case about six years, the practice of paving gullies having been introduced by my predecessor, Captain Cruickshank, only towards the close of 1845. Previous to the general introduction of this improvement, many of the gullies were nothing better than extensive cesspools, never cleaned, and several feet deep in night-soil, their contents being seldom removed by any other agency than that of the monsoon: the general paving and regulation of the gullies had therefore the immediate effect of greatly augmenting the quantity of night-soil daily removed from the Native Town, and the difficulty of disposing of it was proportionably increased.

46. This difficulty was two-fold: in the 1*st* place, the great distance (often exceeding a mile) the Halalcores had to walk before finding a place for the deposit of their sweepings induced them, whenever they found themselves unwatched, to cast down their burden in the first dark corner they found, and thereby much increased the difficulty of keeping the town clean—this was particularly the case in the New Town Districts, on account of their greater distance from the sea-beach; 2*ndly*, on reaching the sea, the sweepers were in the habit of flinging down the filth barely within the line of water, to be scattered in all directions along the shore, thereby occasioning a most horrible nuisance, which would have been obviated if the soil had been at once flung into the deep water, particularly if it had been first allowed to ferment and liquify, so as at once to mix completely with a volume of sea-water sufficiently large to render it inoffensive.

47. To remedy the nuisance arising from the second of these causes in the neighbourhood of Fort George, it was proposed that the Boree Bunder should be so lengthened as to enable the sweepers to empty their baskets into deep water, and it was suggested that as such extension would render the bunder more useful generally, the Government should be requested to contribute half the cost. Government having declined doing so, the whole matter was referred by the Board to Captain Crawford, Acting Superintendent of Repairs, with the suggestion that burying the night-soil in the ground might possibly be a better way of getting rid of it.

48. Captain Crawford in his reply (dated 29th September 1846) reported at length on the subject, enlarging on the two difficulties I have mentioned, and stating that the only way of remedying the first (the evils arising from the great distance of many parts of the town from

the authorised places of deposit) would be to establish receiving places, each consisting of a small paved court, surrounded by a wall 6 or 7 feet high, in different quarters of the town. In these courts night-carts were to be placed for the sweepers of the neighbourhood to empty their baskets into, which carts, when filled, were to be drawn by bullocks to the sea shore, or any other place of deposit that might be determined on. Captain Crawford suggested the establishment of ten such receiving places, at suitable localities in the Native Town.

49. With respect to the places for ultimate deposit, Captain Crawford stated that there were only two ways of getting rid of the night-soil without nuisance—1*st*, by burying it in pits, and 2*nd*, by throwing it into deep water; that for pits of such a nature, the Flats in the neighbourhood of the main drain would be the least objectionable locality, though, from being under water during the rains, they would be only available during the dry season.

50. Captain Crawford enlarged on the "most horrible nuisance" arising from the existing method of flinging down the contents of the sweepers' baskets on the sea shore *instead of into* deep water, and pointed out that the extension of Boree Bunder would remedy the nuisance at one point only; *that Back Bay must be at once rejected as a point for throwing out night-soil into the sea, as it was little more than a dead water*, but that some prominent point should be selected for the purpose, such as the extremity of Colaba or Malabar Point, from which it might be got rid of into the open ocean at once.

51. In reply to this letter, Captain Crawford was requested to submit to the Board some specific plan for giving effect to his suggestions regarding cesspools on the Flats, and receiving places for the sweepers' baskets in the Native Town, and he accordingly, on the 17th October 1846, sent in a plan and estimate for a receiving station at Khara Tank, in the centre of the New Town Districts, for a cesspool by the side of the town drain, and for three iron night-soil carts. This estimate was sanctioned by Government on the 17th February 1847.

52. This was the commencement of the receiving stations, of the cesspools on the Flats, and of the night-soil carts. The latter were at first only three in number, but soon after a large public necessary having been erected at Commattee Poora (also in the New Town Districts), the number of carts was increased to seven (the present number is 40). The position of the Khara Tank receiving station was well chosen: it was nearly in the centre of the New Town Districts, which, as I have before remarked, were those most distant from Back Bay and Chinch Bunder.

53. The establishment of the Khara Tank receiving station did not, even during the fair weather months, sensibly diminish the nuisance in

Back Bay: all the sweepers' baskets of the Oart Districts continued to be thrown there. The night-carts from the Byculla schools, the hospital, the jail, and the large public necessary at Sonapoor, were still emptied there, and its establishment (and that of the night-soil carts) had the effect of materially increasing the nuisance at Back Bay *during the monsoon*, as at that season the cesspools on the Flats were under water, and the seven new night-soil carts had to be emptied on the Back Bay beach.

54. The intolerable nuisances at Back Bay continued, therefore, to increase, and much correspondence ensued on the subject between the Board and the Superintendents of Repairs for the time being—Captain Crawford, Captain Cruickshank, and myself; communications on the subject from the Medical Board and the Military Board were also forwarded to the Board of Conservancy by Government. The compilation of the correspondence that has taken place on the subject of the Back Bay and night-soil nuisance is now nearly seven inches thick, and I shall therefore only attempt to give a general view of what remedies have been suggested, and what carried into effect, when, and by whom, without particularizing every individual communication.

55. For the sake of clearness, I shall also classify the subject-matter of the correspondence in question, and consider each of the kindred subjects it relates to separately. I shall, 1*stly*, recapitulate what has passed regarding the state of Back Bay, and the uses to which it was formerly applied; 2*ndly*, the correspondence that has taken place regarding the construction of the night-soil carts, and the efforts that have been made to compel the sweepers to practice their calling by night only; 3*rdly*, what has taken place regarding the cesspools in the Flats, and the eligibility of the sea-channel of the Love Grove sluices as a place of ultimate deposit; 4*thly*, what has passed regarding the establishment of public necessaries at various sites; 5*thly*, I shall show what is the cubical amount of night-soil to be daily disposed of at Bombay, and discuss the various methods of disposing of it that have from time to time been proposed, giving the details of the method which is in my opinion the one most free from objections, and of which I recommended the adoption.

56. 1*st*, regarding Back Bay. In paragraph 11 of letter No. 212, of the 29th September 1846, Captain Crawford had given it as his opinion, that this locality should at once be rejected as a place for the deposit of night-soil, on account of its being a dead water; still it appeared difficult to get any other place for the purpose, and the nuisance would unquestionably be palliated by any arrangement which would secure the night-soil being emptied as far to the seaward as possible. Captain Crawford therefore suggested that an iron pipe, 18 inches in diameter,

should be laid down from the Sonapoor necessary to seaward for 700 feet (rather more than 100 feet short of low-water mark spring tides). Such pipe was at its termination to be about 2 feet above the level of the sand, and to have a fall of about 1 foot in 60; and it was supposed that with this fall the contents of all sweepers' baskets emptied into the upper end of the pipe would flow through it without stoppage.

57. On resuming charge of the office in 1848, Captain Cruickshank was requested to submit a scheme for abating the nuisance at Back Bay. In his reply he approved the plan proposed by Captain Crawford, and recommended its immediate adoption. He estimated the cost of the iron piping delivered in Bombay at about Rs. 4,000, exclusive of fixing and flushing apparatus.

58. With reference to this recommendation, the Board of Conservancy resolved "that it seemed desirable that the soil should be disposed of otherwise than by being thrown into Back Bay"; and requested the Superintendent of Repairs to give his opinion as to the most desirable temporary expedient for that purpose, and on the subject generally.

59. Captain Cruickshank being at this time obliged, by ill health, to leave Bombay, the consideration of the subject devolved on myself. On the 9th of May, I reported on the subject generally. I stated, in the first place, "that Back Bay was of all localities in the island the very worst adapted for the deposit of privy filth and the embouchure of sewers, inasmuch as it is screened by Colaba and Malabar Point from any tidal currents that might otherwise carry the noxious matter off to sea, and because the filth so detained is, at low-water, owing to the extreme shallowness of the bay, spread over a vast extent of exhaling surface, which is, moreover, situated to the windward of the island." I then stated that the disgusting state of Back Bay was due to four causes: 1*st*, to the non-observance of Article XV. of Regulation III. of 1815, the enforcement of which was a police duty; 2*nd*, to the discharge of four main drains, situated between the Marine lines and Churnee road, and also the drain from the Sonapoor necessary; 3*rd*, to the deposit of night-soil from carts and sweepers' baskets; and 4*th*, the burial, and frequent disinterment during the monsoon, of dead persons and animals in the locality. I stated that "the 1*st* of these causes of nuisance might be put an end to in a week, by causing a couple of mounted policemen, provided with hunting-whips, to patrol the sands during the two hours morning and evening in which the nuisance was principally committed; that the 2*nd* cause of nuisance might probably be removed in a few years, by diverting to another out-fall the sewerage at present discharging itself into Back Bay; that the 3*rd* cause of nuisance would be removed by the establishment of the cemetery on the Flats recommended in Captain Cruickshank's letter No. 28 of 1848; and as a

remedy to the *4th* cause of nuisance, I recommended that the emptying of sweepers' baskets on the sands should be strictly prohibited—that they should be all taken to the Khara Tank station, until one nearer to Girgaum was provided; that the night-soil carts, at least as soon as the setting in of the monsoon should render the cesspools in the Flats inaccessible, should be taken to the Love Grove sluices, and there discharged into the sea-channel, instead of being emptied (as hitherto) on the Back Bay sands; and I recommended that the sea-channel of the main town drain should be substituted as a place of deposit for the cesspools in the Flats in the fair season, as well as during the monsoon."

60. On consideration of this report, the Board of Conservancy resolved on authorising the substitution of the sea-channel of the sluices for the Back Bay sands, as a place of deposit for the night-soil carts during the monsoon, and addressed the Chief Magistrate of Police regarding the enforcement of Article XV. Regulation III. of 1815; but the other two causes of nuisance in Back Bay continued unabated, and the sweepers' baskets of the Oart Districts, and those from the Sonapoor necessary, still continued to be emptied there.

61. On the 30th January 1849 the Board again called the attention of the Superintendent of Repairs to the "extremely offensive state of Back Bay," and requested that he would submit his opinion and report on the best way of putting an end to the nuisance.

62. In my reply of 3rd March I referred the Board to my former report on the subject, and again stated that "the disgusting state of Back Bay was mainly owing to its use as a place of deposit for night-soil; that I thought that all other causes of nuisance were comparatively trivial, and that until such abuse be completely and peremptorily put a stop to, Back Bay must continue a source of nuisance and disease to all who had the misfortune to reside within the reach of the malaria arising from it"; and I stated that "in my opinion the only remedy for the offensive state of Back Bay was to alter the interior arrangement of the Sonapoor privy in such a manner as to allow of its serving also as a place of deposit for the neighbouring Halalcores' baskets, and to admit of the night-soil collected from both these sources being daily emptied into tank-carts, which should be discharged into the sea-channel of the Love Grove sluices during the rains, and into the cesspools in the Flats during the fair weather."

63. On taking this report into consideration, the Board approved of the suggestion that the filth collected in the Sonapoor public necessary should be removed in carts, instead of being thrown into the sea at Back Bay, and called for a plan and estimate for the alterations required for the purpose (which plans and estimates were in due course forwarded); but with reference to the disposal of the filth brought in sweepers'

baskets from other parts of the town to Sonapoor, and there thrown into the sea, the Board requested the Superintendent of Repairs' opinion as to whether it would not be possible to have it deposited in carts placed at different stations in convenient localities for the purpose of receiving it.

64. In reply, I stated that "the immediate neighbourhood of the Sonapoor necessary was then one of the principal places of deposit for sweepers' baskets in the island, and I thought it was preferable rather to deal with the nuisance in its then centralized state than to attempt to diminish it, by diverting a portion of the causes of nuisance into other channels, which were perhaps then comparatively free from it, by the distribution of smaller and more frequent depots for the collection of night-soil, before experience had determined where such smaller depots were really required; that wherever such were wanted, carts would answer the purpose very well, the bullocks always leaving an empty cart in place of the full one they drew away."

65. The plans and estimates for the alterations requisite for the removal in carts of the night-soil previously thrown out on the Back Bay beach were sanctioned by Government on the 8th of March 1850. The improvement was completed in September of the same year, and since that date no night-soil, either from the public privies or from sweepers' baskets, has been permitted to be emptied on the Back Bay beach.

66. The improvement effected in the state of the bay by this alteration (which put a stop to the daily deposit of the fæcal refuse of at least 60,000 persons on its shallow beach) was necessarily very great. The state of the bay is, however, still complained of, and with reason.

67. On the 28th June 1851 Captain Parr, and a number of other gentlemen who were in the habit of riding on the Back Bay sands, memorialized the Board, to the effect that the locality was "still (amongst other nuisances) disgraced by disgusting spectacles, which it was impossible to describe." The same complaint is made, and with equal reason, by the inhabitants of every street in the Native Town and Fort. The offence is one which in Bombay, as in all other cities, it is the duty of the police, and in their power alone, to prevent. I believe that there is no other place in the world where so disgraceful a disregard of decency prevails as at Bombay. It is idle to attempt to keep the town clean, or to teach the inhabitants the value of cleanliness and decency, while they are permitted to indulge in this disgusting offence with impunity, in broad day, and in the public streets (often, too, in the immediate vicinity of the police chowkies, and under the eyes of individual policemen). The practice should be put down with a high hand, and that habitually: no permanent good effect can be produced by seizing a few offenders once a year, and in consequence of some particular representation.

68. I think it perfectly practicable to render Back Bay as wholesome as any other part of the island, by applying the remedies I suggested in my report on the subject of the 9th May 1848. Of the four causes of nuisance which, together with their remedies, I there enumerated, the principal one (that occasioned by the wholesale deposit of night-soil on the beach) has been removed since September 1850; another cause of nuisance will be removed by the establishment (now sanctioned) of a burial ground in the Flats; but the first cause of nuisance I then mentioned (that arising from the non-enforcement by the police of Article XV. Regulation III. of 1815) has been scarcely abated.

69. In the same report I stated that the second cause of nuisance (that occasioned by the four covered drains which discharge into Back Bay) might probably be remedied in a few years by diverting their sewerage water to another outfall. This might be effected by separating the fair-weather sewerage from the surface (or rain-water) drainage, an expedient much advocated in England, and which the extraordinarily small proportion which the fair-weather contents of the Bombay drains bears to their monsoon contents renders peculiarly applicable to this island.

70. The monsoon surface water should still be allowed to flow into Back Bay by the four existing sewers, but a single small catch-water covered drain, or pipe, should intercept the fair-weather sewerage of all four drains, and conduct it either into deep water, or through the low sandy ridge of the cocoanut oarts, into one of the branches of the main town drain. A 9-inch stoneware pipe, with a moderate fall, would suffice for the latter purpose, and it would have no tendency to fill up, as the sewerage before reaching Back Bay has already deposited (in the earlier portion of its course) all the solid matter it originally held in suspension.

71. The English and Mahomedan burial grounds that adjoin Back Bay, and also the enclosure where Hindoos are burnt, should be brought under more stringent police supervision than at present. No burial should take place in either of the two former, until a certificate had been obtained from the police authority in charge that the grave prepared was of a certain specified depth, and not within a certain specified distance of any previous grave, of less than four years old. To secure these objects, it would be desirable that a month's supply of graves should be prepared, approved of, and kept ready in advance.

72. In burning Hindoo bodies, a certain specified proportion of wood should be insisted on, and no human remains not absolutely reduced to the condition of ashes should be permitted to be thrown out on the beach. In riding along Back Bay, I have frequently seen as may as twenty half-charred human skulls, and other human remains of an equally unseemly character, within a space of a hundred yards.

73. Both the English and the Mussulman burial grounds at Back Bay appear to me over-crowded, and I think the establishment of new cemeteries (if possible in the same neighbourhood) will shortly be found desirable. The Eastern slope of Malabar Hill, overlooking Chowpatty and Back Bay, appears to me well adapted for the purpose; the ground, being sheltered from the sea breeze, is not adapted for building purposes, but it is finely broken, and might be laid out and planted into a very picturesque cemetery.

74. The sea beach of Back Bay is, as it were, the lungs of the Native Town, and it is impossible to overrate the importance of keeping it free from all causes of nuisance. I think that a road along it, which would form a sort of "marine parade," would greatly tend to this result, and would also promote the construction of cross-roads from the beach through the oarts to the Native Town, which would much conduce to the efficient ventilation of the latter.

75. Such a road would provide a communication between the Fort and the Breach, Malabar Hill, Chowpatty, and Tardeo, some hundred feet shorter than the existing road through the Native Town. The saving of distance would be comparatively trifling, but the saving of time in driving along a clear unobstructed road, instead of through the narrow streets of a crowded bazar, would be very considerable indeed. The number of persons interested in improving the communication between the Fort and Breach and Malabar Hill has of late years so greatly increased, that I think it would not be difficult to raise among them, by subscription, the amount required for the construction of the present road. The Bellasis road and bridge were similarly made by subscription in 1793.

76. The increasing nuisance resulting from the greatly increased number of the night-soil carts, and from the circumstance of their having of late (ever since the deposit of night-soil at Back Bay was put a stop to) been compelled to traverse roads on which they were formerly unknown, and also the best form of construction for the carts, and the means by which drivers could be obtained, who might be compelled to cart away the filth during the night only, are subjects which have given rise to a large proportion of the correspondence included in the compilation I am now considering.

77. When the practice of carting away the filth of the New Town Districts to cesspools in the Flats was first introduced by Captain Crawford, in 1846, the number of night-soil carts was only three, and when the Cammattee Poora public necessary was built the number was only increased to seven; the present number is forty, or six times what it was when I took charge of the office. Moreover, besides being so much more numerous, the carts which I found at work merely carried

the filth from localities lying between the Grant, Bellasis, and Duncan roads, to cesspools in the Flats, and had therefore no public street of importance to traverse beyond a small portion of the length of Bellasis road. The increase in number of the carts has been almost wholly on account of carting away the night-soil formerly thrown out on the Back Bay sands, and the carts so employed have necessarily to traverse districts much more important and thickly frequented than those lying between Cammattee Poora and Love Grove.

78. The passing and temporary nuisance occasioned by the carts to those who happen to meet them on the roads should, of course, be reduced as much as possible. I think, however, the importance of this objection is much overrated, and my predecessor appears to have been of the same opinion. In alluding to the complaints made by pedestrians on the Bellasis road of a morning, of bad odour when the carts were passing along, Captain Cruickshank remarks (29th February 1848) as follows:—"This (the bad odour) lasts only for a few minutes, and is not, I conceive, of any moment, compared with the benefit of getting such a vast quantity of soil removed from the crowded parts of the town."

79. The first night-soil carts used were constructed of iron, at a cost of Rs. 150 each, and they were not found to last well. Their construction was only sanctioned 11th September 1847, and I presume they could not have come into use till six weeks or two months afterwards. Yet, on the 17th February 1848, Captain Cruickshank reports, that on the Sunday preceding one of them had unfortunately broken down on the Bellasis road, occasioning a great nuisance; and on the 24th of the same month, he further reports that the other carts showed symptoms of decay, and recommended that when others were required, they should be made smaller, and of teakwood, lined with lead. The carts since constructed have been of teakwood, and were found to be perfectly water-tight without any lead lining.

80. The carriage of night-soil was included in the scavenging contract entered into in 1850, (shortly after the great increase in the number of carts had taken place,) and the carts are now furnished by that contractor. Much of the nuisance occasioned by the passage of night-carts has been attributed to their faulty construction, and to their being occasionally uncovered, and not being so easily kept clean as iron ones. It is unnecessary to go through all the correspondence that has taken place on the subject.

81. On the 14th January 1852 the Board requested that I would try as an experiment some improved form of cart, and I accordingly forwarded a tracing and description of a tumbler cart, manufactured by Barret, Exall, and Andrews, and exhibited at the Great Exhibition (No. 128, Class IX.), and to which a premium was awarded by the Worcester

City Commissioners, for the best design of a cart to carry night-soil and the sweepings of towns, which appeared to me admirably adapted to its purpose, and I recommended that the Board should immediately "order out one of these carts as an experiment, and that, if found to answer, the bodies and iron-work of other similar carts be ordered out, leaving for economy of carriage the wheels and wooden-work to be fitted to them here."

82. This recommendation was adopted, and the model cart is now on its way to Bombay. Should this cart be found to answer, I shall recommend that a sufficient number on the same model should be provided at the expense of the Board of Conservancy, and furnished to the scavenging contractor for the time being, who should pay for their use 5 per cent. per annum on their cost, together with whatever may be found necessary to meet their annual depreciation. I should recommend, also, that the same course be adopted with reference to the model water-cart which, at my instance, the Board have ordered from Liverpool.

83. In English towns all these appliances are provided by the Municipality. It is evidently desirable that all such tools should be of the most perfect and improved description; but it cannot be expected that the person who holds the scavenging or road repairing contract for so limited a period (three years) should at his own cost provide anything that would outlast the period of his contract. The rollers used in the repair of the roads are already provided by the Board of Conservancy.

84. I do not, however, imagine that any form of carts will very materially diminish the nuisance experienced by those who meet them. The only real remedy for the inconvenience at present complained of would be some arrangement under which the carts could be compelled to travel at night only. When the night-carts were first established, efforts were made in vain to induce the sweepers to cart away the filth by night: they refused to do so, and insisted on taking the carts by day or not at all, and as they form a body of monopolists, combined by caste, and well aware that their services are indispensable to the public, and that they cannot be compelled to work at all, nothing further could be done in the matter than to prohibit the carts from travelling during the hours of the day at which those most sensible to such annoyance principally frequent the roads, namely from 9 to 11 A. M., and from 4 to 8 P. M.

85. This was not the first attempt that had been made to compel the sweepers to work at night: the number of large baskets of soil (each containing the contents of many privies) carried by the sweepers at all hours of the day through many streets of the Native Town (upwards of 600 being daily carried through the streets forming the approach to Chinch Bunder) has long occasioned a great annoyance to the Native population. In October 1846 the Superintendent of Police determined

to put a stop to the practice, and sweepers with baskets of soil on their heads were forbidden to traverse the streets during the day. The consequence was a general strike of all the Halalcores in the island. Soil accumulated in every gully and privy, occasioning intolerable nuisance. Captain Crawford reported the circumstance to the Board of Conservancy on the 3rd November, and the police restriction was withdrawn. It was thus found necessary to allow the sweepers to revert to their old plan of working by day, and they have continued to do so ever since.

86. In May 1849, another effort was made to palliate the nuisance in question, and I was authorised to invite tenders for doing the work by night only. I did so accordingly, and reported the result. The contractors who attended declined making any tenders at all on such terms (at that time there were only four carts, and the work was done departmentally). "They stated that they had communicated with the Halalcores on the subject, and that they one and all stated that they worked during the day, and drunk and slept during the night; that they at present got only six rupees a month by working by day, but they would not work by night on any terms.

87. On the 5th of June, the Board called for the monthly expenditure incurred in removing night-soil to the places of deposit in the Flats, a work then performed departmentally, and by four carts only; but subsequently, on the number being so generally increased, included in the scavenging contract. On ascertaining the amount to be only Rs. 168 per mensem, the Board on the 10th July 1849 authorised me to engage people to perform the work by night only, at more than double the then rate of pay. This attempt also failed.

88. It was suggested that the Collectors of Poona and Tanna should be applied to, to send down low caste men who would do the work required at night, and break up the combination existing among the sweepers of Bombay. The Board accordingly applied to the Magistrate of Tanna on the subject, and solicited that he would procure the number of sweepers required by the Board in Tanna or elsewhere in his district, at the rate of Rs. 12 per mensem each. Mr. Law replied, on the 6th of September 1849, that no sweeper could be obtained to do the Board's work even at Rs. 12 per month, either from Tanna, Bhewndy, Callian, or Panwell.

89. In December 1850, the old scavenging contract expired, and the carting away of the filth from Sonapoor and other public necessaries was included in the new contract. The alterations in the Back Bay necessary had increased the number of carts nearly six-fold, and the nuisance arising from their passage along the roads was increased more than proportionally on account of the more crowded nature of the districts the new carts had to traverse. I therefore made another attempt

to induce the contractor (over whom, as holding the road repairing contract also, I had considerable influence) to cause the filth to be carried away at night. I at length succeeded partially: though he refused to sign any agreement on the subject, he promised to cart away the filth at night whenever the cesspools in the Flats were available, but he stated that the distance to the Love Grove sluices was too great to allow of doing so when (during the monsoon months) the filth had to be deposited in the latter locality.

90. This proves that if the night-carts are to ply at night only, the place of deposit must be within easy distance of the various receiving stations; and for these reasons, amongst others, I have proposed Chinch Bunder as the place of deposit for the sweepings of the whole town.

91. The cesspools adjoining the main town drain in the Flats were proposed by Captain Crawford on the 17th October 1846, and their execution sanctioned by Government under date 17th February 1847. Those first executed were uncovered; the quantity of filth then deposited in them did not at first exceed six or eight cart-loads a day; the cubical amount of ordure collected there was consequently small, and the pits increased in number but slowly.

92. On the 11th January 1848 Captain Cruickshank reports that the last pit excavated by Captain Crawford, 20 feet long and 10 feet in width and depth, had been filled up in 20 days; and solicited a sanction of Rs. 150 for digging a new pit 50 feet square and 7 feet deep. This was sanctioned, but on the 29th February he reports that, owing to the hardness of the soil, the money had been only sufficient for two pits 25 feet square, and 7 feet deep each.

93. These were the pits in use at the time I took charge of the office on the 2nd March 1848. On the 14th idem I received a communication from the Board, requesting that I would consider whether it would not be advisable to make the new pit longer and narrower than those then in use, which were 25 feet square. In accordance with this suggestion, a pit was made 60 feet long and only 10 wide, but this proportion having been found inconvenient, the dimensions adopted by Captain Crawford were reverted to. In the same resolution the Board requested that I would cause the pits already filled "to be covered over with earth."

94. Orders were given accordingly, but the result was a terrible nuisance; the night-soil was so fluid that the earth sunk to the bottom, and the first pit overflowed a considerable surface. Nothing was then known of the time that night-soil took to dry and consolidate. On reference to my remarks (paragraphs 19, 20, and 21), on the *poudrette* manufactory at Paris, it will be seen that the process of desiccation

there occupies about seven years, though accelerated in every possible manner. In pits under water every monsoon, it cannot be expected that the substance should ever dry at all.

95. On the 1st April 1848, I reported to the Board, that with reference to the request that the pits already filled should be covered over with earth, it was found that the soil in such pits was "much too fluid to support the required covering of earth, and was, I thought, likely to continue so. The covering of earth must therefore be supported by beams overlaid with facines; the estimated cost of which for the two pits was Rs. 174. I added, "as it was absolutely essential that these pits be covered up before the monsoon, and as it was most desirable that they be covered up as soon as possible, I begged leave to solicit immediate sanction for the required outlay."

96. The Board's answer, dated the 4th April 1848, was as follows:—

"Read a letter from Superintendent of Repairs, No. 103, dated 1st April 1848.

"2. Resolved—that the Superintendent of Repairs be informed the Board do not consider it of essential importance that the pits should be covered over, and that they therefore decline sanctioning the proposed work.

"(True extract)
(Signed) "GEORGE HANCOCK,
"Clerk to the Board of Conservancy."

97. From this date (1st April 1848) the pits remained totally uncovered for two years. On the 1st April 1850 I again urged the necessity of covering them. The cost of the pucka covering (of earth, supported by facines laid on stout beams) I had proposed two years previously, and which the Board declined to entertain, was Rs. 87 for each pit. On the 1st April 1850, I therefore suggested a much more economical expedient—"that the pits should be covered up with cudjans and other light material, leaving only, while the pit is in progress of filling, an opening sufficiently large to admit of the discharge of the cart, which opening, when not in use, might be closed by a hurdle covered with cudjans."

98. This plan was sanctioned as an experiment by the Board on the 9th idem, and I was requested "to report on its efficiency at the end of the fair season, and that if I considered a more substantial covering than cudjans, and of sufficient strength to bear a light covering of earth, would be preferable, the Board authorise any additional expense which might be occasioned by the substitution of what the Board consider would be a more effectual means of abating the nuisance." I accordingly substituted bamboo matting, mineral browned, for the cudjans I had proposed.

99. On examining the state of the pits at the end of the fair season, I found no nuisance perceptible on walking all round them, and reported accordingly. The coverings were then, however, completely new, and their good effect has not been so lasting as I had at first anticipated. They are not from their nature calculated to last long; indeed, I do not think that any kind of covering so placed would be durable—and a heavy or bulky one in falling in would cause the pits to overflow, and spread the contents over an area greatly exceeding their own surface. This pollution of the neighbouring surface from the overflowing of the pits occurs to some extent during every monsoon, when the pits are under water; and every year's deposit greatly increases the magnitude of the evil. In short, I am strongly of opinion that the cesspools in the Flats should be abandoned in favour of the sea-channel of the main sewer, in the fine weather as well as in the monsoon, until arrangements can be made for conveying the filth of the whole town into deep water, and a strong tide-way off Chinch Bunder.

100. The substitution of the sea-channel of the main town sewer at Love Grove for the sands at Back Bay as a place of deposit for night-soil was effected in accordance to a recommendation contained in my letter No. 127 of 1848, in answer to the Board's resolution of the 10th March 1848, requesting my opinion as to the most advisable temporary expedient for disposing of the soil otherwise than by throwing it down at Back Bay.

101. No difference of opinion can exist as to the advantage of the embouchure of the main town sewer over the Back Bay sands as a place of deposit for night-soil. Captain Crawford as well as myself has pointed out the peculiar unfitness of Back Bay for such a purpose, and the opinion of the two medical men on the Main Town Drain Committee was strongly expressed to the same effect.

102. I have always been of opinion that the sea-channel of the main drain was a far more eligible place of deposit than the cesspools in the Flats. When I first proposed the substitution of the sea-channel of the main sewer for the Back Bay sands (in my letter No. 27, of the 9th May 1848), written during the fair season, I stated that "as this arrangement would put an end to the existing nuisance (that occasioned by the cesspools in the Flats), and would at the same time involve no additional expense,—the increased distance being insufficient to prevent the tank carts performing, as at present, two trips per diem,—I could see no objection to its immediate adoption."

103. The plan was, however, only adopted during the monsoon, owing, I believe, to its being considered that the cesspools in the Flats might be so managed as to fertilize and increase the value of that neighbourhood, the property of Government, without occasioning

nuisance to the public. Mr. H. Malet, the then Collector of Land Revenue, had a plan for distributing it over a large surface by means of narrow ditches, which I was at one time requested to adopt.

104. The complaints made during the year 1851 by the Committee of the Byculla Club, by the gentleman left in charge of Dr. Kays' houses at Byculla, and by other inhabitants of the same district, regarding the nuisance occasioned by the cesspools in the Flats, induced me at the close of the monsoon of that year to continue the deposit of the night-soil in the sea-channel of the sluices, in preference to resuming the use of the cesspools in the Flats. I considered that by this means the nuisance would be further removed from the thickly populated portion of the island, and the expense of excavating and covering cesspools in the Flats avoided. The occupant of the only house closely adjoining the embouchure of the main sewer complained, however, of the nuisance occasioned to his residence, by the continuance of this deposit during the fair season; and his letter being referred to me, I reported on the subject as follows:—

105. "I have the honour to report that the excremental matter daily produced by our large population must be disposed of somehow and somewhere; that there is no great town in the world, in which there are not large sewers constantly discharging large quantities of excremental matter into the river or harbour in which such town is situated, and that the immediate point of embouchure of such large sewers cannot, under any circumstances, be otherwise than offensive to their *immediate* neighbourhood.

"Now Love Grove is ALREADY the point of embouchure of the great sewer draining four-fifths of our town districts. Moreover, it is at a safe distance from any populous district; there is only one house to be inconvenienced in its neighbourhood: such locality seems, therefore, to me to be much better adapted than the Flats, in the centre of the island, for the deposit of night-soil."

The Board, however, resolved that the use of the cesspools in the Flats during the dry weather should be reverted to.

106. One great advantage of the sea-channel of the sluices over the cesspools in the Flats, as a place of deposit for night-soil, is, that the nuisance occasioned thereby in the sea-channel is not an increasing or accumulating one. The soil is thrown into deep water, dissolved, and eventually carried out to sea and disposed of, *and there is no accumulation;* whereas in the case of the cesspools in the Flats, every new pit opened increases the exhaling surface of night-soil, and the cubical amount of the accumulation.

107. The sluices also possess the advantage of being to windward (with respect to the prevailing winds) of a much smaller population

than the cesspools in the Flats. The wind is very seldom indeed so much in the north as to render any nuisance at the sluices perceptible at Byculla, and the number of houses usually liable to nuisance from this source does not exceed six (those situated immediately north-east of the hay market).

108. The sluices are, therefore, less disadvantageously situated than the cesspools in the Flats, both with reference to the position of the population, and the direction of the prevailing winds. Their distance from the former is, however, in one respect, disadvantageous, inasmuch as it is impossible to get the night-soil carted thither by night.

109. The nuisance so occasioned is, however, of a passing and temporary nature, as compared with the disadvantages of the cesspools in the Flats, as constituting a source of constant nuisance directly to the windward of a large population.

110. Before quitting the subject of the nuisance occasioned to the ground lying between the Grant and Bellasis roads, and to the neighbourhood of the Byculla Flats, by the deposit of the night-soil in the cesspools and at the sluices, I may state that I have been always of opinion that many bad smells were attributed to this and to the Main Drain which were due to other causes not so readily removable.

111. In my letter, No. 105 of 1852, I stated that "the majority of bad smells perceivable on the Flats between Waddington's Bridge and the Bellasis Road were to be attributed to the low caste and filthy habits of the inhabitants of a neighbourhood, the surface of which is, on an average, about 5 feet below high-water mark spring tides, whereby its drainage was rendered difficult and imperfect"; * * * that "it could not be expected that any town containing half a million of people can be without a dirty quarter, and this is particularly the case in India, where the connection of caste has a tendency to concentrate sweepers and others of low castes in one locality. Municipal improvements can only provide the means of cleanliness to those who are willing to avail themselves of them, and the inhabitants of Cammattee Poora are not so.

112. "In Europe a refuse population of the sort would be cooped up in courts and back streets in the heart of the town, from which the principal thoroughfares would be screened by continuous rows of more respectable houses, and the nuisance would, consequently, be less generally perceptible; but in India it seems the rule that the low castes should always inhabit the outskirts of the towns and villages, and the nuisances thereby occasioned are consequently unscreened from the suburban roads."

113. It has been often remarked that the west end is the fashionable quarter of nearly every great city in Europe, and that this is owing to the circumstance of the prevailing winds being in all such cases from

the west, and consequently keeping that quarter clear of the nuisance and miasma inseparable from a concentrated population; but nowhere in Europe is this the case to the same extent as at Bombay. In this island the wind is from the west for four-fifths of the number of hours that compose the year, and no improvement would ever render the tract lying to the windward of a line drawn from the Love Grove sluices to the English burial ground equally wholesome and equally valuable as suburban building ground to the ridge and western slope of the Malabar Hill, Breach, and Worlee range.

114. If the relative value of land on the Flats and at the Breach and Malabar Hill be any criterion, the public seem well aware of the inherent comparative disadvantage of the latter district. Most people who live beyond the town limits have daily business in the Fort, and it might be expected, therefore, that the value of suburban ground would be proportionate to its distance from the Fort, yet the distance from the Fort being the same in each case, the market value of land at the Breach and Malabar Hill is from five to ten times as great as that of ground on the Flats. For instance, large quanties of ground have been taken lately for the railway and foras roads in the neighbourhood of the bungalow lately occupied by the Honorable J. P. Willoughby, and the price at which the owners of the various plots having given up their ground, without appealing to a jury in a single case, has been Rs. 5 per burga, or 1 anna and 4 pies per square yard; the distance from the Church Gate being only 6,000 yards, and the road the best in Bombay, and altogether free from ascents and descents.

115. There has also been a great deal of land on Malabar Hill and the Breach thrown into the market lately from the estates of Dadabhoy and Muncherjee Pestonjee, and the late Framjee Cowasjee, and I believe the average of the sales effected to have been considerably above 6 annas a yard (or five times more than the ground near Mr. Willoughby's bungalow), and in many instances as high as 12 annas, or even 1 rupee per yard, yet the distance from the Fort is one-sixth greater, and the road a very hilly one. The sea breeze is, in my opinion, felt with equal strength at both sites. The only reason that can be assigned for the market value of ground in the one locality being five times greater than it is at the other, is the general recognition of the inherent disadvantage of the Flats as building ground.

116. These disadvantages are not likely to diminish. The progress of drainage in the Native Town will greatly increase the amount of offensive matter brought down by the main town drain, nor will the covering over of the latter remedy the evil. The more liquid portion of the sewerage will be constantly discharged at the Love Grove sluices, and must necessarily render the adjoining shore offensive at low water, and the

annual removal of the sediment deposited within the covered portion of the drain will still occasion the nuisance described as follows in the 12th paragraph of the report to Government of the Committee appointed to report on the main drain nuisance in July 1850 :—

117. "12. In the main town drain, in addition to the sediment taken out from the portion of its course already covered, 60,000 cubic feet are annually removed, at an average expense of Rs. 1,500 from the earlier portion of its further and uncovered course. Its removal occupies six weeks of every fine season. During its removal, the nuisance along the whole course of the drain is extreme ; the sewerage water is bunded up in one portion of the drain to allow of the sediment being removed from another, the mud, as fast as it is removed from the bottom, being thrown on the banks. The evil would *not* be remedied by arching over the drain. The deposit would not thereby be diminished : it must of necessity be still annually removed, and its removal from a covered drain would be less easy and economical, and would occupy much more time than from an open one."

118. I have already, in my letter No. 231 of 1852, pointed out the impossibility of draining the Flats during the monsoon, or indeed for some months after, owing to the Flats being the site of a former salt lagoon, from which the sea is now only kept out by artificial means. The rain water falling in a basin nearly 15 square miles in area can only escape at certain times of tide, and through comparatively small openings : the level character of the surface and the clayey nature of its soil is also much against its draining or drying rapidly.

119. The utility of providing public necessaries for the poorer classes is a point on which some difference of opinion exists at Bombay. It is urged against them that centralization in such matters is unavoidably productive of very serious nuisance to the neighbourhood in which it takes place, and the Back Bay or Sonapoor necessary is adduced as a case in point.

120. It is also objected, that the erection of public necessaries has had no sensible effect in diminishing the nuisance occasioned by the non-observance of Article XV. Regulation III. of 1815, an instance of which is afforded by the fact of there being no locality in the island more abused in this way than the open ground immediately adjoining the public necessary at Cammattee Poora.

121. The first objection is valid only against very large public necessaries. It must be admitted that those of very large size are productive of unavoidable nuisance, but if of moderate size (like the experimental one in Shaik Abdoola Packmodia Street), it has been proved that they may easily be kept altogether free from nuisance; a number of small ones conveniently situated are also much more conducive than a single

large one to the observance of Article XV. Regulation III. of 1815, greatly diminishing the temptation to infringe such Act, by placing the accommodation required within easy distance of all.

122. Public necessaries are in my opinion indispensable at Bombay, because a large proportion of our labouring population inhabit lodging-houses too densely crowded to admit of private accommodation to the requisite extent. It is essential to the cleanliness of the town that Article XV. Regulation III. of 1815 should be strictly enforced by the police, yet it would be a hardship to enforce this Regulation strictly without first providing such accommodation as would enable the poorer classes to observe it.

123. The public necessary at Sonapoor was erected by Captain Suart in 1839, at the cost of Rs. 9,372, and the Cammattee Poora necessary by Captain Crawford in 1847, at a cost of Rs. 4,082-12-2. On the 5th May 1847 Captain Crawford forwarded plans and estimates for a public necessary he proposed to construct at Chinch Bunder, on a much larger scale than either of the preceding: the estimate amounted to Rs. 26,995, and Captain Crawford thought that the amount might probably be increased by contingencies to Rs. 30,000. Some correspondence ensued regarding this plan, and when I took charge of the office of Superintendent of Repairs, in March 1848, it was still under consideration. My opinion was requested regarding it by the Board.

124. On the 25th March I reported that I disapproved of the plan, principally on account of the distance many of those for whose use it was intended would have to traverse in reaching it, and promised to send in a plan for *necessaries on a smaller scale.* In my report of the 9th May 1848, on the state of Back Bay, I observed, with reference to this subject, "that the existing arrangements for getting rid of the night-soil of Bombay appeared to me very inadequate both to the population of the town and to the sanitary importance of the object; and that I proposed to bring the subject more fully to the notice of the Board in a future communication"; and in the following month, in the memorandum on the works of improvements proposed for the next season, embodied in the 10th paragraph of the Board of Conservancy's report to Government for the year 1847-48, I wrote as follows:—

125. "The necessity for an organized and more efficient system for the abatement of the various nuisances incidental to the deposit and disposal of night-soil is daily increasing. This has in a great measure arisen from the number of gullies which have been paved during the last three years. In their former state the night-soil was suffered to accumulate in them until it was removed, if at all, in carts which carried it in mass to a considerable distance. The Halalcores who are now

obliged to clean the paved gullies daily, instead of taking their sweepings to a distance, empty their baskets at the first out-of-the-way place they come to. The remedy proposed for this evil is the diffusion of public necessaries on a small scale, so constructed as to serve as a place of deposit for the neighbouring Halalcores' baskets, and to admit of the night-soil thus collected being daily emptied into the tank-carts, which, according to the new arrangement, are to travel only at night, and to be emptied into the sea-channel of the Love Grove sluices instead of into cesspools on the Flats, or in Back Bay, as heretofore."

126. On the return of the fair weather (October 1848), I accordingly forwarded a plan for an experimental public necessary of the description recommended in the above paragraph of the Board's report, to be erected in Shaik Abdoola Packmodia Street. The plan was immediately sanctioned and executed, and the building, though too small for its locality, has been ever since found to answer its purpose extremely well.

127. I shall now proceed to consider the proportion the means provided for the conveyance of night-soil from the Native Town bears to the numerical amount of its population.

128. Before doing so, I may, however, state that the soil produced in the various outlying suburbs is thrown out by the sweepers, either on the adjoining coasts or in inland situations, into the first out-of-the-way corner they come to, and in rural districts no material nuisance is occasioned by such practice.

129. The soil of the Fort is thrown into the sea at Boree Bunder, also on the shore of Mody Bay, outside Rampart Row east, access being had by a sally-port. This latter site is the usual public necessary of the poorer classes of the Fort population. This portion of the beach being about to be reclaimed from the sea, some other arrangement will be required for their accommodation.

130. The Native or Black Town contains in round numbers a population of 390,000. According to Liebig, the average quantity of soil produced by a town population is about a quarter of a pound per day each, or 97,500 lbs., equal to 43 tons 10 cwt. and 60 lbs. daily for the whole. Assuming the specific gravity to be about that of water, and the weight of a cubic foot of water at 1,000 oz., the cubic amount of night-soil to be provided for daily would be 1,560 cubic feet. 12 cubic feet is as much as a pair of the bullocks at present in use can draw away. Carriage for 130 cart-loads should be therefore provided daily. The number of carts-loads for which provision is actually made under the Board's present arrangements does not exceed forty, or not quite one-third of the total required.

131. But in addition to the amount so carted away at the expense of the Municipal Fund, a large quantity is thrown out in baskets at

Chinch Bunder. By placing Purvoes to count the number of baskets there emptied, I have ascertained the average number to be about 668 large baskets daily. On measuring the size of the description of baskets used, it was found that about fifteen went to a cart-load, and that the total amount of night-soil at present thrown out on the rocks at Chinch Bunder was therefore about 44 cart-loads daily.

132. This is an over-estimate, as the baskets are never quite filled. I should say that in fact the amount thrown out in baskets at Chinch Bunder, with that taken away by the night-carts, does not, taking both together, exceed one-half of the total quantity produced. Of the remaining half, I believe that about one moiety is deposited in the streets and on various vacant plots of ground in the Native Town, in violation of Article XV. Regulation III. of 1815, and the other half is composed of the contents of sweepers' baskets thrown down in out-of-the-way places.

133. Were the soil of the Fort carted away also, carriage for nearly 17 cart-loads daily must be provided; this is calculating one cart-load daily to each 3,000 souls. The total number of cart-loads of soil produced daily in the Fort and Native Town cannot be, therefore, far short of 150 of 12 cubic feet each.

134. Five different modes of disposing of the night-soil of Bombay have at various times been proposed. They are as follows:—

1*st*.—Throwing it out into deep water, so that the soil should be immediately mixed with a volume of water, compared with which its own bulk would be as nothing, and selecting, if possible, for the purpose, a locality where at certain times of tide a current out to sea may be obtainable.

2*nd*.—Conveying it to sea by means of the sewers.

3*rd*.—Shipping it on board boats, and then conveying it out to sea.

4*th*.—Burning it.

5*th*.—Conveying it out of Bombay by railroad.

Of these propositions I consider the first and last the only practical ones, and of these two I think the first that likely to be attended with the least nuisance, and to be certainly the most economical.

135. In the first place, to enforce the cleanliness of the town, it is essential that Article XV. Regulation III. of 1815 should be strictly enforced by the police, and in order to render its observance practicable, the remedy recommended in paragraph 10 of the Board of Conservancy's report to Government of 1847-48 should be adopted, viz. "the diffusion of public necessaries on a small scale, so constructed as to serve also as a place of deposit for the neighbouring Halalcores' baskets, and to admit of the soil so collected being carried away" (by the cart placed beneath each necessary, the full cart removed being replaced by an empty one). There should be one of these necessaries and

Halalcores' stations to every 3,000 or 4,000 of the population; the number of cells contained by each should be 12 or 16; and necessaries of this plan and size may be so constructed and managed as to be altogether free from nuisance. The soil so collected should be carted away *by night* in carts, similar to the model now on its way from England, to the place of final deposit.

136. With reference to the best locality for this purpose, in my letter No. 283 of 1851, I proposed "that arrangements should be made for sending all the night-soil of the town out to sea *at Chinch Bunder*."

137. I propose, that on arriving at this locality the carts should empty their contents into large cast-iron covered tanks, supported and enclosed by masonry, situated on the rocks between high and low-water mark. In these tanks the soil should be allowed to remain for twenty-four hours, by which time the whole will have become dissolved into a homogeneous liquid, capable of mixing with water immediately and entirely.

138. From the lowest part of these tanks a large iron pipe, furnished with gun-metal sluices, should descend a moderate inclination, until it reached the level of the water at half tide, at a point where at that time of tide there would always be a sufficient depth of water.

139. At some time every one or two days, when the tide was falling, and half out, at which time the projection of bunders to the southward would always occasion a strong current out into deep water, the sluices of one of the tanks should be drawn up, and its liquified contents allowed to rush out through the pipe. The liquid soil would then escape into a volume of water, compared with which its own bulk would be as nothing. With a 14-inch pipe, the amount of night-soil (about 80 cart-loads) at present carried by sweepers and carts out of the Native Town would escape in from 3 to 4½ minutes.* It would immediately be hurried off by the current, and absorbed in the enormous volume of water it was brought in contact with.

140. The process of letting it off would, I believe, occasion no nuisance that would be perceptible either from the shore or shipping; at any rate, the process would only occupy a few minutes during each twenty-four or forty-eight hours, whereas the nuisance at present occasioned by nearly 700 large baskets of soil being daily thrown down on the adjacent rocks is constant, and indescribably offensive.

141. I should propose in the first instance to erect two tanks, to be used alternately, one always full and the other filling, and a third might be added whenever the increase of the town rendered it necessary.

* By Hawksley's formula the time required would be nearly 4½ minutes, but according to the results of the experimental works of the Metropoliton Consolidated Commission of Sewers, rather less than 3 minutes.

Each tank should be 20 feet long, and 10 wide and deep. With these dimensions, the capacity of each would be 2,000 cubic feet, or about 166 cart-loads—more than twice the total quantity at present taken from the Native Town by the night-carts and sweepers' baskets taken together.

142. The tanks should be composed of cast-iron plates bolted together, on a masonry foundation, and enclosed in masonry; they should be covered by brick arching on cast-iron girders. The brick arching should support a paved platform for the carts, with trap-doors, through which they might be emptied into the tanks beneath; there should, of course, be a sloped approach from the present road to the platform, and a parapet round the latter.

143. On this platform should be a fixed fire-engine or force pump, with its suction pipe tipping into a well in the rocks (which would be filled each tide) for washing the carts by means of a high-pressure fan-shaped jet of water, such as is now used for scavenging streets. To prevent occasioning nuisance on the rocks, the water so employed should afterwards run into the iron tanks, where its quantity would not be sufficient to occasion inconvenience.

144. I consider the advantages of this plan are as follows:—It would terminate the nuisance caused by night-carts travelling by day; the great difficulty at present experienced in getting them to ply at night only being occasioned by the distance of the pits in the Flats, and the Love Grove sluices, from the Sonapoor receiving place, and the Native Town generally, but Chinch Bunder is only one mile and three furlongs from the Sonapoor beach, and less than half a mile from Poydownee, the centre of the Native Town. Poydownee is seven times further from the Love Grove sluices, and nearly five times as far from the pits in the Flats, as it is from Chinch Bunder. Were the place of ultimate deposit situated at Chinch Bunder, there would be no difficulty in compelling the carts to ply at night only, when the present contract expires.

145. The advantages which an apparatus on the plan I have proposed would possess over a pier extending from Chinch Bunder into deep water, and terminating in a tipping platform, are, that while the tanks would afford a convenient receptacle, available *at all times of tide*, for the contents of the carts and sweepers' baskets, the soil would be retained in them, *and not allowed to escape into the sea until it had attained a thoroughly fluid and soluble condition;* moreover, that the time of such discharge might be exactly regulated, so as only to take place at times of tide when there was a strong current from the shore, and a sufficient depth of water at the termination of the pipe.

146. The construction would not, I think, be found more expensive than that of a pier, because the latter would require deep water at its termination *at all times of tide*, and must therefore extend much

further out than it would be necessary to extend the piping; moreover, the latter would be so much less costly than an equal length of pier, that I think the difference would be sufficient to defray the cost of the tanks and sluices.

147. I do not think that any material nuisance would be occasioned by the discharge of the soil even during the few minutes it lasted: there would be no extensive exhaling surface of offensive matter to taint the breeze, and owing to the rapid inclination of the pipe, the liquified soil would escape with a velocity that would carry it some feet under water, where it would be completely absorbed by the vast volume of salt water with which it would be brought in contact. At the time of discharge, the orifice of the pipe need not be more than a foot or eighteen inches above the water, and the surface of soil exposed (in its descent into the sea) to the breeze, could not be sufficient to taint the latter.

148. I think that the proposed arrangement would have a most beneficial effect on the state of the shore adjoining Chinch Bunder, and on its approaches. The quantity of night-soil carried down Poydowney street would certainly be greatly increased; but as the carts would only travel by night, such increase would occasion no nuisance to the inhabitants. The quantity at present carried down this street by day (averaging 668 large baskets daily) would be very much diminished, as the greater part of it would be collected in the various receiving stations, and carried down in the carts *by night*. There can be no question but that the state of the shore would be very greatly improved by the proposed arrangement. At present nearly 700 basket-loads of soil are thrown down on it daily, and the nuisance occasioned by the practice is indescribable.

149. I shall now proceed to discuss the other plans that have from time to time been proposed for the disposal of the night-soil of Bombay.

The second proposal of those enumerated in paragraph 134 was that the soil should be conveyed to the sea by means of the sewers. I have already shown, that even in the constantly rainy climate of England, where the flow of liquid in the sewers for each individual of the population is more than fifty-fold greater than it is at Bombay,* no soil, except

* By letter No. 356, of the 19th December 1853, the Board sanctioned the experiment of obtaining by mechanical means an artificial out-fall for the contents of the main town drain, and this sanction has enabled me to carry out the plan for obtaining an artificial out-fall which I had recommended in my above quoted letter, No. 303, of the 1st August last. In the first place, the flow of sewerage through the channel of the main town drain was accurately measured. The lower portion of the drain was emptied of its contents, and the sewerage of the upper portion retained at its usual level by means of a dam. Immediately below this dam I had two brick tankees constructed side by side, the capacity of each being 825 gallons. A dammered wooden gutter was laid from the level of the sewerage accumulated behind this dam to these tankees, arrangements being made for instantaneously diverting the flow of the sewerage from one tankee to the other at pleasure. A large leather hose communicated with the bottom of each tankee, its orifice being hooked up while the tankee was filling, and let down for the purpose of emptying it. The sewerage water was allowed to run through the wooden channel into these tankees alternately: the instant the first was filled the current was

that which comes from closets, accompanied by a sufficient volume of water to carry it off, can be admitted into the sewers. This method of disposing of the night-soil is therefore clearly out of the question at Bombay.

150. The project next enumerated in paragraph 134 was, that the soil should be shipped off in peculiarly constructed boats, and emptied into deep water, at some distance from the shore. The Board of Conservancy requested the opinion of Captain Crawford (then Acting Superintendent of Repairs) as to the feasibility of this project. On the 13th October 1846, Captain Crawford replied, that on considering the subject he feared that the plan of such boats would not be found to answer: that the first and great objection to them would be that it would be impossible to get lascars to work them; secondly, that *if an establishment could be trained* to the purpose, it would be large and expensive, and that the construction of the boats would be very expensive likewise. Captain Crawford added, that he hoped shortly to submit to the Board a plan, which he thought would possess all the advantages to be gained by boats, without the trouble and cost of a permanent establishment.

151. The plan in question was the laying down of a line of piping, extending, at an inclination of one in sixty, from high-water to low-water mark, the contents of all the sweepers' baskets being emptied into the high-water end of the pipe, flowing through it, and emerging at a point where in most states of the tide there would be some depth of water with which it might mix. By this arrangement, the nuisance occasioned by the promiscuous emptying of the sweepers' baskets at all levels on the beach would have been very greatly ameliorated; but two of the principal objects to be realized by the apparatus I have recommended, viz. the restriction of all discharges of soil into the sea to times of tide at which a current off shore may be obtained, and the prevention of its escape until it had become liquified, and immediately soluble in salt water, (which it is not in its fresh state,) could not have been attained by Captain Crawford's arrangement.

152. I quite concur in Captain Crawford's objections to the use of boats; and in addition to those he enumerated, I believe that in practice

diverted into the second, and long before the second was full, the first was emptied, and ready for filling again. By this apparatus, the flow of liquid down the sewer was accurately measured for 96 hours continuously, from 6 A. M. on the 25th of April to 6 A. M. on the 29th. The measurement was continued, and accurately noted, night and day, by myself and the European members of my establishment, keeping watches of three hours each. During these 96 hours 326,276 gallons of sewerage passed through the channel, giving a daily average of 81,569 gallons. The daily totals, and also the rate of flow at the same hours each day, corresponded very closely; but the flow (as is usually the case with sewerage) was by no means equally spread over the 24 hours: the flow was at its minimum (about 22 gallons a minute) from about a quarter to 12 (noon) to a quarter to 1 P. M.; it then increased suddenly (usually within half an hour) to 80 or 85 gallons a minute. It continued to flow at this rate till about 6 P. M., after which the decline was gradual, till the minimum was again reached at about noon next day. I also found by experiment, that the daily flow of 81,569 gallons was adequate to the irrigation of 10 acres of garden ground, so as to allow every part to be saturated once in four days.

great nuisance would be found to be inseparable fron the process of loading the boats from the carts, however costly and complete the apparatus and establishment provided for the purpose might be.

153. In addition to the cost of *at least* three boats (two of them at alternate use, and a third to replace either of the other under repair), a pier must be provided, from which the carts (or their contents only) might be shipped at all times of tide, for any plan to be adopted *must* provide a receptacle for the sweepers' carts and baskets, available at all times of tide. To compel the sweepers to confine their operation to the hour of night would be the utmost restriction that would be found practicable: it would never do, in addition to this restriction, to tie them down to particular times of tide *also;*—such an arrangement, like many others proposed, might look very well on paper, but it could not possibly be carried out in practice at such a place as Bombay.

154. After considering the project of disposing of the night-soil by shipping it off in boats of peculiar construction long and carefully, I have come to the conclusion that it would be one of the most costly that could be adopted; that it would be very troublesome and expensive to manage; and that under the best management would be liable to very great nuisance.

155. Burning has also been proposed as a method of disposing of the night-soil of Bombay. It would be a very costly method, and likely, in my opinion, to be productive of considerable nuisance. I have shown that the amount of soil to be daily disposed of is between 40 and 50 tons. The substance could not be burnt until the liquid portion was driven off in vapour. According to Liebig, fresh fæces contains 75 per cent. of liquid matter (the dry residue of 25 per cent. being composed of three parts of carbon, and one of ash). I do not think, therefore, that the combustion of one pound of coal could evaporate to dryness more than four pounds of night-soil; then 44 tons of night-soil a day would require for its evaporation to dryness 11 tons of coals, at a cost of about Rs. 100 daily; and I do not think that the substitution of wood for coal would diminish the expense.

156. Moreover, the process would, in my opinion, occasion great nuisance: the liquid portion of the night-soil, forming 75 per cent. of its whole bulk, would be expanded 1800 times by the process of vaporization, and from the way in which smoke and vapour often appear to descend and rest on the surface of the low parts of the town during the early morning, I believe, however high a chimney were provided, the steam of the boiling ordure would occasion serious nuisance in certain states of the atmosphere, which are by no means of rare occurrence.

157. The *5th* and last of the projects for the disposal of night-soil enumerated in paragraph 134 was that it should be carted to a paved court-yard near Chinch Bunder, and thence conveyed by railway to the salt marshes of Salsette.

158. I think that this plan would be more liable to nuisance than that which I have recommended. I do not think its first expense would be less, and its working would be certainly much more costly, much more troublesome, and much less certain.

159. I am not sure that the Railway Company would consent to carry off the soil at all, and if they did agree to do so, they would insist on taking it by a special train, to avoid inconveniencing their other traffic by two otherwise unnecessary stoppages, and because no Hindoo would go in a train to which night-carts were attached (indeed I am not sure whether the fact of the railway carrying night-soil *at any time* would not prevent Hindoos from travelling by it at all); and the expense of a daily special train would be very considerable.

160. I believe that the court-yard in which the night-soil would be transferred from the night-carts to the railway tank-waggons that were to convey it to Salsette could be scarcely managed so as not to become a source of considerable nuisance.

161. A double set of railway tank-waggons would be always in use, one set in process of filling, while the other was either ready for the train, or on its way to Salsette. In addition to this double set, there must be a proportion of spare tank-waggons to replace those under repair. These repairs would be a matter of great difficulty, as no Native workmen can be induced to touch a cart that has been once employed for the carriage of soil. The first cost of the railway tank-waggons would be from £70 to £80 each, the cost of the waggons employed for the carriage of iron, &c. on mineral railways, such as the Saffvale, being from £60 upwards.

162. The court-yard would require to be laid with lines of rail which should communicate with the railway. At the Salsette end there must be considerable length of rail laid, probably not less than a quarter of a mile, to convey the tank-waggons to a proper place of deposit, and means must be provided for dragging them that distance; at the terminus there must be also another court-yard, with wells, force-pumps, and all necessary appliances for washing the carts, and two establishments must be kept up, one for the Chinch Bunder court-yard, and the other for the Salsette terminus.

163. The system to be adopted for the disposal of the night-soil should be one that would work with ease, simplicity, and certainty, and as much as possible without the intervention of establishments, which last I consider objectionable, not so much on the score of

expense, as because an arrangement which depends for its proper working on the efficiency and regularity of a complicated establishment can never be depended on.

164. This railway plan does not fulfil these conditions nearly so fully as the one I have recommended. It is much less simple : it would require a much more costly establishment; and the system of railway tank-waggons would be infinitely more liable to accident and decay than the cast-iron tanks and piping fixed in masonry, as suggested in paragraph 137.

165. In August and September 1851, the Board of Conservancy resolved that Colonel Waddington, Captains Turner, Cruickshank, and Crawford, Drs. Leith, Downes, and Buist, and Mr. LeGeyt, should be requested to favour the Board with any suggestion they might be able to afford, as to the best mode of disposing of the night-soil of the island. These gentlemen were accordingly applied to, and answers have been received from Colonel Waddington, Captains Turner, Cruickshank, and Crawford, and Dr. Leith.

166. The remedies advocated by such of these officers as have proposed any specific alteration are generally those which have been already discussed. I shall therefore take those remedies *seriatim*, and epitomise what each officer has said regarding each of them—first premising that it is desirable that the plan adopted should be one applicable to the circumstances of *every part of the town*, and not to only a small section of it.

167. The plan which is discussed in paragraph 144, for disposing of the night-soil of the town by conveying it to the sea through the sewers, is alluded to by Colonel Waddington, Captain Turner, Captain Cruickshank, and Captain Crawford.

168. Captain Turner considers that the fall of the portion of the town near Nowrojee Hill is sufficient to allow of its soil being carried off by underground drainage, but that for the low lying districts of the town he can suggest no better means for the removal of soil than those at present in use, except the discontinuance of the deposit at Love Grove.

169. Captain Turner says, that he has been induced to alter his opinion regarding the feasibility of removing the soil of the *upper* portion of the town by underground sewerage by what he has recently seen in England.

170. It must be remembered, however, that in respect to rain, England is situated within the zone of constant precipitation, "and Bombay within that of the periodic rains."

171. Moreover, even in England no soil, except from water-closets, is allowed admission into the sewers, and I have recently ascertained that the flow of water in the sewers of Bombay per head of population is only one-fiftieth of the English proportion.

172. Captain Crawford says:—"Though much might possibly be done *in some parts of the town* by house-drainage, this could only be effected by an entirely new system of sewerage, and a considerable change in the customs of the inhabitants; *and there would still remain extensive portions of the town to which, from their level and low situations, the plan could hardly be applied effectually at all.*"

173. Colonel Waddington is of the same opinion, but very correctly observes, that even with the most improved system of sewerage a great increase in the water supply and water consumption of the inhabitants would be necessary to keep the drains clear. Captain Cruickshank considers the carrying off of night-soil by means of sewers impracticable in Bombay.

174. Captain Cruickshank is the first who alludes to the plan proposed in 1846 for disposing of the soil by shipping it off to the harbour. As his letter regarding the whole subject is short, I give it entire:—

175. "I am sorry to have to report my inability to suggest any efficient means for attaining the object in view. I fear the evils complained of will always be more or less experienced in Bombay, owing to the impracticability of carrying off the night-soil by means of sewers; and the only way that occurs to me for getting rid of the deposit, for nine months in the year, is the conveying it in decked lighters to the mouth of the harbour, outside the island of Kenery, by means of a steam tug, and allowing it to escape through a double valve in the bottom of the lighter into the open sea."

176. Dr. Leith says that the most feasible plan that occurs to him is of the same nature. Captain Crawford repeats the objection to the use of boats already cited in paragraph 150.

177. None of the officers consulted allude to the plan of burning the night-soil.

178. With reference to the plan for removing the soil by railway, described in paragraphs 157—164, Captain Turner says:—"When the railway is completed, I think it might be advantageously removed from the island, and used for fertilizing Salsette"; and Captain Crawford mentions it as "one other plan which he thinks offers itself for consideration."

179. There are two other remedies suggested in the correspondence, which have not previously been discussed. Captain Turner says, that some of the chemical disinfecting solutions now generally used in English sick-rooms and hospitals should be used for rendering the soil of the town inoffensive.

180. I fear that these solutions, though excellently adapted to the sweetening of a sick-room, would not be found applicable to a mass of soil exceeding 40 tons daily. The disinfecting processes patented

in England, France, and Belgium ten years ago, whereby night-soil was to be instantaneously converted into a valuable and perfectly inoffensive manure, have not as yet been applied in any town in England, or, to the extent of my information, in any continental town either. The most recent Parliamentary reports on the subject speak of it as a project the feasibility of which (though the patent is ten years old) is not yet established. If it had been practicable, it would have been doubtless applied ere this by the wealthy municipalities of London, Paris, or New York.

181. Colonel Waddington's proposition I will give in his own words :—

" In former years, private necessaries were not so much in use in Bombay, and were chiefly confined to those who could afford to employ sweepers for the removal of soil. The bulk of the inhabitants frequented the sea beach, and under certain regulations I am of opinion that such a practice is the least objectionable, the most conducive to cleanliness, and the cheapest of all methods. It might be difficult now to bring the people back to this custom, but I should advocate the attempt to do so."

182. The population of the Native Town is nearly 400,000 ; all access for the inhabitants to its harbour sea-frontage is prevented by the line of bunders extending its whole length; their termination at Chinch Bunder is the only point of access to the eastern beach ; the number who could make use of that beach would be therefore very limited, and the great bulk of the population must have recourse to Back Bay, were Colonel Waddington's proposition adopted.

183. I do not think the crowd on Back Bay sands on cocoanut-day usually exceeds 10 or 15,000, but even taking it at 30,000, it would be only one-sixth as large as the crowd that would assemble morning and evening on the Back Bay sands if only one-half of the population were to follow Colonel Waddington's recommendation.

184. Most of the officers consulted advocate an improvement in the description of cart and cattle employed in the conveyance of night-soil, and that the sweepers should be compelled to travel at night. Perhaps some stringent regulation to this effect might be introduced in the new Nuisance Act.

185. Captain Crawford concurs with me in advocating, for the disposal of the soil, an arrangement by which it might be conveyed through pipes into deep water. He says (paragraph 5) :—" Respecting the disposal of the soil, I have ever held one opinion, which is, that it might, without proving any nuisance, be thrown into the sea at any point, if proper provision only is made for its being perfectly, and with certainty, so deposited as to be at once mixed with a bulk of water compared with which its own bulk would be nothing. The means of

attaining this end, suggested by Captain Crawford, are described in paragraph 151.

186. The Board have already, in their letter No. 134 of 1852, addressed to Mr. Secretary Lumsden, epitomized all that has passed on the subject of the burial grounds on the Flats.

187. That any site would be better than that at present in use, no one who has ever ridden along the Back Bay sands during the monsoon can doubt; the quantity of bones of horses, oxen, and men, that strew the beach, affording sufficient proof of the frequent disinterment of such remains during the rainy season.

188. Great apprehensions are, however, entertained that the burial ground in the flats would be a source of nuisance to the adjacent districts. Were proper precautions taken regarding the depth of the graves, I am sure that no nuisance would ensue; and the precautions I should suggest are as follows:—

189. That the burial ground be divided into three rectangular portions—one for buffaloes and horses, one for oxen, and one for men; and that the graves dug in each division should be of a certain specified size and depth, never departed from.

190. That to facilitate the proper laying out of the graves, each division should be sub-divided by narrow walks at right angles to each other, and that at regular intervals along the side of these walks—of say ten graves apart—stone posts should be fixed, from which, to similar stones in other walks, a string might be extended, for the purpose of further facilitating the regular laying out of the graves.

191. That a plan should be lithographed, showing all these divisions, walks, and posts, together with all the graves properly laid down, which each of these divisions would hold.

192. That before the burying ground was used, a surveyor should from such plan peg out the position of one or more months' supply of each description of grave; that the digging of them should be let by contract, and that when completed, and before being used, the whole batch should be guaged, and any deficiency in depth or size amended.

193. In this way the proper depth of all the graves used might be ensured by a month's supply of graves already approved of being always kept in readiness; and the observance of this rule might be ensured by the inspection of a European constable once a month.

194. On the lithographed plans of the burial ground, the graves, as fast as they are excavated, should be tinted yellow, and when filled up a blue tint should be overlaid, which would make it green. The plan should be so "written up" once a month.

195. I am by no means an advocate for intramural interment, but the site of the proposed burial ground in the Flats is further from the

town than the suburban cemetery of any large European town I can at present call to mind; and under proper regulation I am convinced that a burial ground on the Flats would be unobjectionable.

196. The removal of dead cattle from the Native Town to the place of burial would be an equal nuisance whether the cemetery was on the Flats or at Matoonga. The same portion of the town would have to be traversed, and by the same number of carcasses.

197. I should nevertheless be glad to see some other site than the Flats selected for the intended cemetery, because I believe, that were it placed on the Flats, many of the existing nuisances of that low-lying locality would be incorrectly attributed to the burial place.

198. Another site might possibly be obtained in Ghorupdavy Bay (near the Powder Works), or by the salt-pans north of it, or near those north of Sewree.

199. In this case the cost of the carriage of the dead cattle and low caste Hindoos would be much increased, and it is questionable whether such increase would not bear hardly on the latter class of Natives, and whether Government would be willing to pay the additional expense of conveying the cattle to so much greater a distance. The removing and burying of dead cattle is done by the police, and the cost is not a charge to the Board of Conservancy.

200. As connected with the subject of the Bombay burial grounds generally, I may remark that enactments for their proper regulation are urgently called for, and should be inserted in the new Nuisance Act. The Mahomedan burial grounds in Grant Road and Back Bay are often very offensive, and I think the nuisance is to be solely attributed to the shallowness of the graves. The Coroner tells me, that in disintering corpses buried there, he has found the depth of the graves not to exceed 2 or 3 feet. In such soft ground this is inexcusable—6 feet should be the minimum.

201. I have already brought to the notice of the Board of Conservancy the commencement of a new burial ground in Mungulwady Oart, which I consider very objectionably situated with reference to the adjacent houses. The existing Nuisance Act unfortunately gives the Court of Petty Sessions no power for dealing with such a case, and the Native population adjoining such nuisances could seldom be persuaded to prosecute them in the Supreme Court.

H. CONYBEARE,
Superintendent of Repairs.

Bombay, Superintendent of Repairs' Office, 18th August 1852.

NOTE TO PARAGRAPH 5.

Extracts from the Evidence of Mr. J. DARKE, *Contractor for Cleansing, as to the Obstacles to Cleansing, and the Conversion of the Refuse of the Metropolis to productive use; also from the Evidence of* Mr. T. TREBBLE, *former Contractor, and also in extensive business as a Nightman, as to the same subject (from the "General Report on the Sanitary Condition of the Labouring Poor," pp.* 379—381).

1. *The Leakage of Cesspools pollutes the adjacent ground.*—Mr. DARKE.—"The cesspools not being lined with hydraulic cement, the volume of their contents is much diminished by the escape of the liquid refuse into the ground adjoining."

Mr. TREBBLE.—"In digging the foundation of old houses for new buildings, the earth is found to be saturated" (with the leakage of adjacent cesspools); "we have frequently to empty one person's place because it is found that the soil has penetrated through to the neighbour's house. This affects the condition of the house, and for the sake of the house, and for keeping a dry foundation, it would be good economy to have water-closets and good drainage from the house to the sewers; but to effect cleansing on this principle, it would be, of course, necessary to have water laid on to each house."

2. *Cost of emptying the Cesspools.*—Mr. DARKE.—"The charge (per annum) for removing night-soil from the poorest tenements may be about £1 per tenement."

Mr. TREBBLE.—"The full charge made to respectable private houses for emptying cesspools is 15*s.* a load, but the contract price is about 10*s.* a load. The period of emptying is dependent on whether there is any leakage from the cesspool, or whether there are any land springs. About £1 per tenement per annum would perhaps be the expense one with another." (N. B.—The number of tenements in London is nearly 300,000.)

3. *Carting the only mode of Conveyance employed.*—Mr. DARKE.—"We do not convey the soil away from London by canal: there is a penalty in the Local Act of £5 for depositing it on the wharf. We do not convey such manure by railway. There is no mode of conveyance provided. The charge is I believe a half-penny per mile, but that is for the use of the rails only; and the Company do not favour the transit of manure, and the farmer or contractor who would convey it must provide engines for himself, which, again, would not pay. Night-soil has not yet been used systematically, and there are no places provided for its reception."

4. *The Expense of Carting is usually much greater than the Value of the Soil as Manure, and confines its Productive Use within very narrow Limits.*—Mr. DARKE.—"There is no filth in the Metropolis that now, as a general rule, will pay the expense of collection and removal by cart, except the ashes from the houses, and the soap lees from the soap-boilers; and some of the night-soil from the east end of the town, where there happen to be in the immediate vicinity some market gardens, where it can be used at once, without distant or expensive cartage. The distance from the Metropolis at which the refuse is used is limited by the cost of cartage, which of course increases with the distance. The average extent of the use of soil as a manure does not exceed three miles from the Post Office district of the city of London. Some night-soil has been dried, and sent to the West Indies for use as manure, *packed up in the return sugar hogsheads!*"

Mr. TREBBLE.—"In general, the soil bears no value to nightmen as a manure. *One hindrance to any removal to a distance is, that by the police regulations, cesspools can only be emptied in the night within certain hours.* This prevents cartage to any great distance, and cartage is very dear. *Some nightmen have paid 6d. per load for the liberty of depositing it.* The object of the nightmen is to get rid of the soil early, and return with the cart, to complete the emptying in one night."

5. *Want of proper Receptacles for the Filth.*—Mr. DARKE.—" *The great practical difficulty to the cleansing of the Metropolis arises from the want of proper receptacles for the filth.* Night-soil has not yet been used systematically, and there are no places provided for its reception."

Mr. TREBBLE.—" Some nightmen have paid 6*d.* per load for the liberty of depositing it. The object of the nightmen is to get rid of the soil early, and return with the cart to complete the emptying in one night. *Formerly, before the new police were so much about, the men would empty the cart in any bye-street or place where they could; they would, when it was in a liquid state, empty it down the sewers; they do so now when they have an opportunity, and return to complete the job.* Formerly the site of the New London University was a place in which the refuse was deposited; so was the site of the new row of grand houses in Hyde Park Gardens. I think the site of Belgrave Square was another place of deposit; *but those places being built over, there is now much difficulty in getting rid of the refuse.*"

APPENDIX I.

[*Appendix I has been already published in the "Selections from Government Records," No. I.*]

APPENDIX J.

[*Appendix J, being unfinished at the date of Mr. Conybeare's departure for England, will be published separately hereafter.*]

APPENDIX K.

REPORT ON THE INTRODUCTION OF GAS ILLUMINATION AT BOMBAY.

No. 235 of 1853.

To C. F. COLLIER, Esq.,

Acting Clerk to the Board of Conservancy.

Sir,

With reference to the documents on the subject of gas illumination noted in the margin, and referred to me for opinion, I have the honour to report as follows:—

Prospectus of the Oriental Gas Company—received 31st May.

Letter from Directors of said Company (without date), to the Board of Conservancy—received 31st May.

Letter from Mr. Secretary Lumsden, dated 25th May, forwarding for the Board's opinion a letter dated the 9th May, from the Provisional Secretary of the proposed Bombay Gas Company—received 31st May.

Letter from the Provisional Secretary of the proposed Bombay Gas Company to the Board of Conservancy, dated 28th idem—received 31st May.

Letter from Directors of Oriental Gas Company, dated 19th April, to the Board of Conservancy—received 14th June.

Copy of a letter dated the 4th of May, from the Directors of the said Company to the Honorable the Court of Directors—received 14th June.

Another letter from Directors of the Oriental Gas Company to the Board of Conservancy, dated 9th May—received 14th June.

2. There are now four parties or Companies in the field, offering to light Bombay with gas.

3. The first of these was the "Patent Vegetable Oil Gas Company," whose prospectus and propositions were forwarded to me for report on the 28th September 1852. The second is a wealthy firm of gas-fitters at Manchester, who are already in communication with the municipal authorities at Calcutta, and have applied to me through a Bombay house of agency for local information previous to making similar overtures at Bombay. The third is the "Oriental Gas Company," whose prospectus is dated the 9th of April 1853, and whose letter to the Board of Conservancy has now been forwarded to me for report. And fourthly, there is the proposal for forming a coal or oil Gas Company at Bombay, the Provisional Secretary of which intended company addressed Government on the 9th, and the Board on the 28th of May.

4. Each of these companies or parties would require, before investing capital in such an undertaking, a grant of the exclusive privilege of lighting the town by gas for a limited period, say of 30 years, and

(due precautions being of course taken for preventing excessive charges) it is in my opinion highly expedient, and even necessary, in order to induce any company to undertake the risk, that such exclusive privilege should be conceded. Hence arises the necessity of selecting one out of the four parties at present in the field.

5. Without pronouncing an opinion on the comparative claims of each of these to public favour, I shall proceed to consider, with the view of rendering the question before the Government and the public more precise—

1*st*.—What concessions any one of these companies would probably require from the local authorities?

2*nd*.—What guarantees the authorities and the public would in return expect from the particular company selected?

3*rd*.—What preliminary steps the Government, the Bench, and the Board of Conservancy, can take in the present early stage of proceedings, to assist and encourage undertakings of the nature in question?

4*th*.—What data exist for determining whether such an undertaking would be remunerative; or, in other words, what is the probable gas-consuming capabilities of the Native population?

5*th*.—What description of gas, whether coal or oil, would be cheapest for Bombay, and on what scale would it be most prudent to commence the manufacture in the first instance?

6. Regarding the 1*st* of these points, I am of opinion that any joint stock company, before incurring the risk inseparable from such an undertaking in India, would require from the authorities—

1*st*.—A guarantee of the exclusive right of supplying gas to the inhabitants of Bombay for a limited period of years.

2*nd*.—A convenient site for their works.

3*rd*.—Contracts on reasonable terms for all public lighting required in the streets or public establishments.

4*th*.—That all materials for their works should be allowed to be imported duty free.

7. On the other hand, the authorities would require of the company selected—

1*st*.—To be satisfied that it was in all respects fully competent to perform what it undertook—that it was possessed of sufficient *bonâ fide* capital, and also of *English connection*, which would prevent its paying double the proper value for everything it ordered out; and that its officers possessed the thorough practical knowledge of all the technical details of the subject essential to the efficient establishment and management of such an undertaking.

8. It would not do to have a second edition of the Bombay Steam Navigation Company. That company had no exclusive privilege, and

the failure of its expectations has therefore occasioned no practical inconvenience; but with a privileged Gas Company the case would be altogether different. The privilege might indeed be withdrawn, but the failure of the first company would discourage others from coming forward, and even could another company be formed under such circumstances, the disposal of the old company's plant (works, piping, &c.) would occasion delay and embarrassment in clearing the ground for the new one.

9. *2nd.*—The authorities would require some security that the public lights should be supplied with gas of good quality, and at a moderate rate. Private consumers would require no protection, for oil is so uncommonly cheap at Bombay (and it is capable of being rendered still cheaper and better by very simple improvements in its manufacture, the Native presses being so bad as to leave nearly half the oil in the cake) that the gas must be very good and excessively cheap to tempt the people to give up their old habits, and to go to the expense of putting up gas fittings, gasometers, &c. in each house supplied, subjecting themselves at the same time to the REGULAR and *punctually* ENFORCED yearly or half-yearly demands of the Gas Company.

10. *3rd.*—The slight depth beneath the surface at which the drains of so low-lying a town as Bombay are unavoidably laid may possibly render it difficult to lay the gas pipes in the streets that are drained with a centre sewer and cross-drains, without rendering some alteration of the latter necessary. In such cases, and in all others in which the drainage or road surface is interfered with, the Gas Company should be bound to make good all damages incidental to their operations.

11. I now come to the *3rd* point to be considered, viz. what *immediate* preliminary steps can the authorities take in so early a stage of proceedings as the present to encourage the undertaking in question?

12. The authorities may in the first place consider and take legal advice regarding the terms of the exclusive "charter" they would be prepared to concede to the company selected.

2nd.—As regards a site for the gas works. One intending Gas Company had fixed on the ground now occupied by the temporary railway terminus as the site of its proposed works. This site, or indeed any other on the Esplanade, would, I presume, be objected to by the military authorities. But Mody Bay, which it is proposed to fill in for the permanent railway terminus and other purposes, would afford an equally convenient locality for the gas works, and sufficient additional ground might probably be reclaimed there without any material increase to the length of the sea wall already estimated for. From one to two and a half acres would be all that would be required for the purpose. The latter amount is the space occupied by one of the largest

gas works ever designed, containing 400 retorts, 12 gasometers, capable of storing 1,000,000 cubic feet of gas, having coal stores capable of holding 10,000 tons of coal, and everything else complete, and on a similar scale. Works on a much smaller scale than this would suffice for Bombay.

13. The Board might also cause to be prepared without delay, for the information of intending Gas Companies, a classified abstract of the house assessment of each street, showing the number of houses in each assessed at above Rs. 70 per mensem, at between Rs. 70 and 50, Rs. 50 and 40, Rs. 40 and 30, Rs. 30 and 25, and Rs. 25 and 20, &c. &c., with the length of each street. All intending gas speculators who have written to me on the subject of calculating the probable gas-consuming power of the population have urged the importance of such information.

14. Any maps that are required can be inspected at my office.

15. All intending Gas Companies are also anxious to know—1*st*, what is the present number and cost of the public lights maintained? and 2*nd*, what increased number the authorities would be prepared to pay for, and at what rate, in case of gas illumination being introduced?

16. The first question is easily answered. The number of public lights at present maintained is 50; they are lighted from dusk to midnight nightly throughout the four rainy months, and also on all but bright moonlight nights during the fair season. Altogether they are lighted 1,680 hours in the year, and the actual cost is Rs. 16-12-9 each per annum, or Rs. 1-6-5 each per month.

17. The second question is a very difficult one to answer. An extraordinary impatience of taxation for local improvement prevails amongst the house-owner interest at Bombay. Some time since about Rs. 25,000 per annum was taken by Government from the very inadequate funds hitherto appropriated to sanitary improvement, for the purpose of augmenting the police, and it was proposed to the Bench to make good the deficiency by increasing the house assessment 1 per cent. (from 5 to 6 per cent.)*

18. The question was referred by the Bench to a Sub-Committee. I protested against this at the time (as a Member of the Bench), on the grounds, that judging from precedent, such a reference was equivalent to shelving the question altogether. The meeting was thereon assured that *this* Committee would lose no time in reporting on the subject they had taken in hand. Nevertheless, nearly two years have since been allowed to elapse, and no report is yet forthcoming, and meanwhile

* The Calcutta house assessment being 6½ per cent. on the *gross* value of the properties assessed, which is equal to 7 per cent. by the Bombay mode of assessment on the *net* value only.

the funds available for sanitary improvement are diminished by between Rs. 20,000 and Rs. 30,000 per annum. Judging from this, there would appear to be little chance of any special rate for providing additional public lights ever being imposed with the approval of the Bench as at present constituted.

19. There remains the method adopted in the new Municipal Act at Calcutta, which obliges every tenant of a house valued at Rs. 70 per month and upwards to maintain a street-light during the whole night opposite his dwelling.

20. This method is both ineffective and unfair: it is ineffective, because at Calcutta only one house in thirteen is rated at above Rs. 70 a month, and in the streets of the Native Town and Fort of Bombay, I should say the proportion which would be compelled to keep up a light under such an enactment would be less than one house in forty.

21. Obviously, a light here and there like this would be of no real use at all; but even supposing there were a sufficient number of highly rated houses in each street for its complete illumination, why should the burden of lighting a thoroughfare for the benefit of the thousands that pass along it be thrown on so limited a class as those who inhabit houses worth Rs. 70 a month within it? The only fair way of defraying the cost of lighting the streets of a town is evidently by an uniform rate per cent. on all fixed property within it.

22. I now come to the *4th* point I proposed to discuss—"What data exist for determining the extent to which the introduction of gas illumination at Bombay would be probably remunerative?"

23. English gas companies look for remuneration to the income to be derived—*1st*, from public or street-lights; *2nd*, from theatres, manufactories, and other large consumers; *3rd*, from shop-lights, and the domestic consumption of gas.

24. In a Parliamentary return of some of the large London Gas Companies, I find the first company in the list gives the proportion of each great class of consumers as follows:—2,248 street-lamps, 3,894 theatre lamps, 10,660 private lights. In the returns of other companies, the proportion of private lights to street-lights is nearly in a similar proportion.

25. I have already stated that we at present maintain 50 public lights only for 1,680 hours each yearly, at an expense of Rs. 16-12-9 per annum, or Rs. 1-6-5 per month. The cost of each light may be otherwise stated at Rs. 1 per 100 hours' illumination.

26. At Calcutta, according to the *Friend of India*, there are about 400 public lights maintained by the municipal authorities, and the cost of a street-light maintained for the whole of every night (4,380 hours per annum) is stated by the same authority at Rs. 3-8-0 per mensem; the cost

of each light may be therefore stated at Rs. 1 for each 102 hours' illumination, a rate not differing materially from that of Bombay.

27. In England, I find from Parliamentary returns of the statistics of different gas companies, that the quantity of gas consumed in each street-light per hour is most usually 5 cubic feet. In the 16 towns included in the return in question, it is in seven cases 5 cubic feet per hour; in six cases 4 cubic feet per hour; in one 3½ feet; in one 2 feet; and in one, 1 foot. The difference is principally due to the description of burner employed, and to the various illuminating powers of gases made from different coals. The number of hours in the year, during which the street-lamps are lighted, varies in different English towns, —from 2,600 hours to 4,327 hours per annum,—the latter being the more usual.

28. Taking the consumption of each street gas-light at 5 cubic feet per hour, the annual consumption per light per annum would be 21,900 cubic feet, say 22,000 cubic feet: were the lamps lighted as at Calcutta, and as generally in England, for the *whole* of *every* night, what would be the probable cost of this 22,000 cubic feet of coal gas in India?

29. Mr. Thornton, the Provisional Secretary to the proposed Bombay Gas Company, in his letter to Government of the 9th May, paragraph 5, states, *as the result of careful calculation*, that "at present" (*i. e.* at the present prices of coal, which it is hoped ultimately to reduce) "*leaving an ample margin for contingencies*, it appears it" (gas) "may be remuneratively supplied to consumers at a cost of Rs. 2½ per 1000 cubic feet."

30. But in Mr. Thornton's letter to the Board of the 28th May, this Rs. 2½ per 1000 cubic feet has already swelled to Rs. 4½ per 1000 cubic feet. Mr. Thornton says (paragraph 3)—"the price of gas will not exceed the London rate of *nine shillings* per 1000 cubic feet. This price is calculated in the event of coal gas being introduced."

31. The result I have arrived at is that coal gas of good quality cannot certainly be remuneratively supplied at Calcutta or Bombay *below* Rs. 5 per 1000 cubic feet. At this rate, the cost of the 22,000 cubic feet required for maintaining each street-light, consuming 5 cubic feet per hour, for the *whole* of *every* night, would be Rs. 110 per annum.

32. The amount might be diminished by only lighting the lamps for a *portion* of every night, or by using an inferior burner. Moreover, gas companies in England generally supply the street-lights at a considerably lower rate than private ones. From a letter I received from Captain Barber last mail, I learn that the Oriental Gas Company propose to supply the street-lights at Bombay and Calcutta at Rs. 70 per annum each, subject to an annual reduction of Rs. 1 during the time of the grant; and this appears to me a very reasonable rate.

33 It must be remembered, that in the case of street-lights, in

addition to the consumption of gas, there is the expense of lighting, extinguishing, cleaning, and repairing the lamps, and also the first cost of the lamps, posts, and piping to be considered.

34. The street-lights supplied by the Oriental Gas Company at Rs. 70 per annum would be of course infinitely superior to the wretched lamps for which we at present pay Rs. 16-12-9 yearly; but it must be remembered that these latter are the worst of their kind, and that a well constructed oil-lamp is capable of yielding a brighter light than coal gas, and that (as I shall presently show) at a smaller cost than coal gas, where oil is so cheap as in India.

35. Next to street-lights in an English Gas Company's list of "large consumers" come manufactories, theatres, churches, public offices, &c.

36. In English manufacturing towns, the manufactories are very large consumers of gas. Indeed, the first practical application of gas illumination in England was to light manufactories. No manufactories, public offices, theatres, or churches, would require to be lighted in Bombay. Taking into consideration the low price of oil here, and the first cost of gas fittings, I think it would be found the reverse of economical to employ gas where only *occasional* lighting is required. The same objection applies with much greater force to the application of gas to illuminations occurring so seldom as that of the Dewallee, or those usual on the occasion of Native marriages. Even on occasions of public rejoicing in London, where gas is much cheaper than it could be made in Bombay, and oil four times as dear, for every single gas illumination met with, there are at least ten oil ones to be seen.

37. But three-fourths or more of the gas sold by English companies is supplied, not to large consumers, but for private lights; and if a similar demand could be expected at Bombay, the want of large consumers would not be very materially felt. I shall, therefore, now proceed to consider to what extent it is probable that gas-lighting would be used by the Native population in their shops and dwellings.

38. I believe, that by far the greater portion of the private lights supplied by the London Gas Companies would be found to be used for lighting shops, and there would be no demand of this sort at Bombay—no "early closing moment" is wanted here, for all shops save two or three chemists' are habitually closed immediately after sunset.

39. Gas is sparingly used in London for domestic lighting: notwithstanding the low rate of gas, and the greatly higher cost of oil or candle illumination, the old mode maintains an unquestionable supremacy in houses of all classes; and of course this would be much more the case in India, where coal gas would be considerably dearer than in England, and oil illumination four times as cheap.

40. Gas is generally used in the houses of English towns for hall

door, stair-case, and passage-lights, but for bed-room lights, and to some extent for those used in sitting-rooms, portability is a requisite. It may be said that chamber "night-lights" do not require to be portable. Nevertheless, gas is seldom if ever used for lights of that description. The objection to its use for the fixed lights of sitting-rooms is that it is an unbecoming light, and a peculiarly trying one to the eyes for reading or working by.*

41. The domestic consumption of gas is increasing considerably in the northern districts of England: this is due to its increased cheapness and purity, and also to improvements in burners, and other appliances. It is, moreover, coming into use for cooking purposes,† and as a substitute for open coal fires. For the latter purpose a grate is provided, as if for a coal fire, but the space usually allotted to fuel is filled by a series of pipes, pierced so as to allow of the exit of jets of gas; and above these, sheets of asbestos are arranged so as to get red hot when the gas is lighted. The whole then presents the appearance of an open fire of red hot coals, interspersed with jets of flame. Such a fire is lighted and put out at a moment's notice, and the grate requires no cleaning.

42. The probable domestic consumption of gas in a foreign town, where it is to be introduced for the first time, will depend principally on the domestic habits of the population, with reference to their evening occupations and amusements, and their hour of retiring to rest; and also on the mode and extent to which they are accustomed to light up the various rooms of their dwellings.

* For the first reason, ball-rooms are never lighted by gas. It is said that when gas was first introduced, it was tried for lighting them, but that ladies unanimously declared against it.

Before gas illumination could be used in miscroscopic investigations, it was found necessary to invent an "achromatic gas-lamp." Quekett, the standard authority on the subject, says, in the appendix to his last edition (1852), after recapitulating the advantages of gas, "on account of its cleanliness, being ever ready for immediate use, never requiring to be trimmed, and the perfect control over its flame," goes on: "when employed in the ordinary way for miscroscopic investigations, it however presents the defect of a glaring yellow flame, the reflected rays from which are exceedingly trying and injurious to the eyes, and likewise renders the definition obscure." He then proceeds to describe the arrangement by which these defects are obviated. This consists of two thickness of coloured glass, the inner of "patent achromatic blue glass," and outer of "neutral tint glass." "The inner blue glass absorbs the yellow rays of the flame to a great extent, but it still gives a glaring objectionable light, which the outer neutral tint glass corrects; and the combination of the two tints affords a soft white light."

† *Roasting by Gas.*—During the past week, two trials have been made on a large scale of practice, at Greenwich Hospital, under the direction of M. Soyer, the distinguished professor of the gastronomic art, to ascertain the economy of roasting by gas. The experiments were made in the presence of the Governor Sir C. Adam, and lady, Sir J. Liddle, M.D., Lieutenant Rouse, General Superintendent, Lieutenant Monk, and Messrs. Lee and Seville, Inspectors of Works, and the apparatus employed was one constructed by, and under the patent of, Messrs.

43. In one of the letters of gas inquiries which have been forwarded to me for answer and opinion, it was stated by an intending gas speculator, who possessed a thorough practical knowledge of the subject, and had had extended experience in the application of gas to the lighting of English towns, that a very good idea of the probable gas-consuming power of a town population might be formed by going through the streets of the town to be supplied between the hours of 9 and 10, and observing the extent to which the houses were lit up: at these hours there are very few lighted houses to be seen in the streets of Bombay, except in Duncan Road and Bhendy Bazar.

44. In fact, the domestic expenditure of the middling and lower classes of Hindoos is porportionably as small in light as in food: they begin to light their lamps at dusk, usually one in the verandah of their houses, one in the hall or general sitting-room, and a third in the eating-room. In houses of the middling class, the two first are what is called tumbler lights, with a single wick, exactly similar to what Europeans in India use as night-lights. The eating-room light is a brass lamp, on the principle of the antique Greek and Roman lamps, but with orifices for a larger number of wicks. As the women do not eat till the men have finished, one of these lamps is sufficient for a family of the average number. Each of these lamps consumes the same quantity of oil as a single wick tumbler light. In general, all three lights are extinguished by about 10½ o'clock. Besides these larger

Smith and Phillips, of Skinner Street, Snow-hill, which was noticed in No. 1473 of the *Mechanics' Magazine*.

The first experiment took place on the 8th instant, when thirty-six legs of mutton, weighing together 288 lbs., or on an average 8 lbs. each, were roasted at a cost of 14*d*. This result being conclusive on the general question of economy, it was determined to have a further trial, in order to ascertain the merits of the principle in detail.

The second experiment was tried accordingly on the 11th instant, on which occasion equal weights of mutton were cooked, and the following results were obtained:—Twenty-three joints, weighing 184 lbs., were roasted at a cost of 10½*d*., with gas supplied at 4*s*. per 1000 feet. When cooked, the above weight of meat was found to weigh 145 lbs., dripping 19 lbs., and gravy, or osmazome, 2¾ lbs.; thus showing the actual loss to be 18¾ lbs. Twenty-three joints of mutton were also cooked in the usual way, as adopted at the institution; namely in one of Count Rumford's ovens, hitherto considered the most economical. When put in they weighed 184 lbs., when done 132 lbs., dripping 18 lbs., gravy none; thus showing a loss of 34 lbs. The coke consumed in this oven was 102 lbs., coal 30 lbs.; thus proving the great economy of gas over the oven, by a saving of 13 lbs. of meat, 1 lb. of dripping, and 2¾ lbs. of gravy. The value of the saving is as follows: Meat, at 6*d*. per pound, 6*s*. 6*d*.; dripping, at 5*d*. per pound, 5*d*.; and gravy, at 1*s*. 6*d*. per pound, 4*s*. 1½*d*.; making a total of 11*s*. 0½*d*.

The saving in time and trouble appears still more remarkable; for the gas being lighted, the dome of the apparatus is opened, and the meat put into it, when it is again closed. M. Soyer and everybody retires from the kitchen, which is locked up, and allowing two hours and twenty minutes for the cooking, it is found perfectly effected. All the authorities of the hospital present, and the connoisseur, expressed themselves extremely well pleased at these satisfactory results.—*Mechanics' Magazine, March* 1853.

lights, there are night-lights (also lighted from dusk) in every bed-room in use, and they are always kept up all night in rooms where there are children. These night-lamps are generally of brass, in the houses of the middling classes. In the houses of the richer class, there would be more than one light in the verandah—there would be tumbler lights instead of night-lights, and of course more oil consumed; but there is much less difference between the habits and domestic expenditure (except in servants) of the upper and middling classes of Hindoos than is the case in a European population.

45. It is evident, that if the difference of cost between coal gas and oil be *in India* at all in favour of gas, it will be so to a very much smaller extent than was the case in England when gas was first introduced there; for a voyage of twelve thousand miles must of necessity render the coal of which gas is made materially dearer in Bombay than in England, and more than seven gallons of the best quality of oil used for illumination in India may be purchased for the same money that a single gallon of the best quality of oil used for the same purpose in England would cost, and five gallons of the cheapest quality used here for the price of a single gallon of the most inferior kind used for illumination in England.

46. The latest and most authentic experiments on the cost of illumination are those of Dr. Ure, described in the Supplement to the last edition of his Dictionary of Arts and Manufactures. From these experiments I have compiled the following table,* and as Dr. Ure gives the weight of cocoanut oil consumed in obtaining a given standard amount (arbitrarily called 100) of illumination, and its cost at the London price of 4*s.* 6*d.* per gallon, it is easy, by substituting the Bombay price, to show what would be the cost of obtaining 100 of illumination with cocoanut oil in India.

47. Dr. Ure found that the light most equitable and free from flickering was that afforded by well made wax candles, sheltered from the wind; he therefore selected these as the standard of comparison. He found that eleven of them, consuming each 128 grains of wax per hour, yielded the same amount of light that had been taken for the standard in some recent French experiments; and the light given by these eleven candles having been ascertained by photometrical measurement, and called 100, the light given by other candles and oil lamps, each consuming an ascertained quantity of oil, tallow, or composition per hour, was similarly measured, and the results reduced to the common standard. A photometer of the usual construction (on the

* In expressing the specific gravity of *gases*, atmospheric air is taken as the standard of comparison; whereas water at 62° is the standard with which solids and liquids are compared.

comparison of shadows principle) was employed in these measurements, and its indications verified by Wheatstone's photometer.

48. The following table exhibits the economical results :—

No.	Description of Light.	Price of Oil, Wax, or Composition.	Specific Gravity.	Cost per hour of 100 of Illumination.
1	Parker's hot oil-lamp, with southern whale oil, at ..	*s.* *d.* 2 6 per gallon.	0·926	0·4875, or nearly $\frac{1}{2}d.$
	Do. do. at Bombay, with fish oil, at	0 $8\frac{1}{4}$ *do.*	.....	1·100, „ $\frac{1}{8}d.$, *or* $1_{\frac{1}{10}}$ *pie.*
	Do. do. do. with refuse castor oil, at	0 6 *do.*	.....	0·800, „ $\frac{1}{10}d.$, *or* $\frac{4}{5}$ *pie.*
2	Mechanical or carcel lamp, with sperm oil	8 0 do.	0·874	1·2804, „ $1\frac{1}{4}d.$
3	Parker's hot oil-lamp, with sperm oil	8 0 do.	0·874	0·902, „ $1d.$
4	Do. do. common olive oil	5 6 do.	0·914	0·900, „ $1d.$
5	Do. do. cocoanut alime or oil	4 6 do.	0·925	0·031, „ $1d.$
	Do. do. at Bombay, with cocoanut oil, at	1 3 *do.*		2·222, „ $2\frac{2}{9}$ *pie,* $\frac{1}{4}d.$
6	French lamp in general use, with sperm oil	8 0 do.	0·874	1·7072, „ $1\frac{3}{4}d.$
7	Wax candles	2 6 per lb.	0·960	5·892, „ $6d.$
8	Spermaceti candles	2 0 do.	.....	5·352, „ $5\frac{1}{4}d.$
9	German wax (stearic acid) candles	1 4 do.	.....	4·224, „ $4\frac{1}{4}d.$
10	Palmer's spreading wick candles	0 10 do.	.....	2·800, „ $2\frac{3}{4}d.$
11	Tallow (mould) candles ...	0 9 do.	.....	2·520, „ $2\frac{1}{2}d.$
12	Cocoanut stearine, of Price and Co.	0 10 do.	.....	4·41, „ $4\frac{1}{2}d.$
13	Coal gas argand burner, consuming 5 cubic feet per hour	10 0 per 1000 c.ft.	0·500	$\frac{1}{2}d.$, or $4\frac{1}{2}$ pie.

49. I have added the lines in *Italics :* they show the cost at which, at Bombay prices, 100 of illumination might be obtained with the description of oil specified in each case, and I have classed the cheapest oils used at Bombay for illumination* (viz. fish oil and coarse castor oil) with the cheapest oil used for a similar purpose in England.

50. In stating the quantity of coal gas required for the production of 100 of illumination at so small an amount as 5 cubic feet per hour, I

* The wholesale prices of cocoanut and fish oil (given in the foregoing table) I have obtained from a merchant who sends to England large quantities of both : the price for fish oil is that at which it is shipped at Calicut, and does not include the freight to Bombay, which is usually Rs. $1\frac{1}{2}$ per hhd. The price at which the refuse castor oil, used for illumination by the lower order, sells, I obtained from Mr. Rogers, who manufactures castor oil on a large scale.

have, I believe, overstated the economy of gas as an illuminating agent by fully 20 per cent. where argands are used, and by more than 100 per cent. where burners of the simpler and more usual construction are employed ; but I was desirous of giving gas fair play in the comparison.

51. Dr. Ure, in his experiments, found that a gas argand London lamp, with 12 holes in a circle of $\frac{3}{4}$-inch diameter, and a flame of 3 inches long, afforded a light of only $78\frac{1}{2}$ per cent. of the standard of 100 (which standard illumination had been attained by the consumption of as much cocoanut oil as would cost $\frac{1}{4}d.$ an hour at the Bombay price). Dr. Ure does not state the number of cubic feet of gas consumed in the experiment, but from other standard authorities, it appears that the consumption of a 12 hole argand burner, used with London gas, would be about 5 cubic feet. Mr. Pickstone, in his "Practical Treatise on Gas Lighting," page 28, states 5 feet of ordinary London coal gas to be equal to 12 mould candles only, and Dr. Ure shows that it requires on an average 14 of such candles (even when so large as 3 to the pound) to equal his standard of 100 of illumination. According to Mr. Pickstone, therefore, 5 cubic feet of London coal gas would only produce 85 per cent. of the standard (100) of illumination.

52. But assuming that 5 cubic feet of coal gas really did produce 100 of illumination, the cost (at 10*s.* per 1000 cubic feet) would be $\frac{1}{2}d.$ or about $4\frac{1}{2}$ pie per hour ; whereas the same amount of light may be obtained with cocoanut oil at a cost of $\frac{1}{4}d.$ or $2\frac{1}{2}$ pies, and with refuse castor oil for $\frac{3}{4}$ pie or $\frac{1}{10}d.$ per hour.

53. The amount of gas required for the production of 100 of illumination depends—1*st*, on the quality or specific gravity of the gas. All coals yield nearly the same volume of gas, but the specific gravity of the gas varies according to the quantity of carbon it contains, and on this depends its illuminating power, which (for similar volumes) is three times as great in the best gas as in the worst. (The specific gravity of coal gas ranges from ·407 to ·737, atmospheric air being taken as unity.)

54. The 2*nd* condition that affects the amount of gas required for the production of 100 of illumination is the description of burner employed, the simplest forms being the worst. The most perfect combustion, and therefore the most economical result, is obtained where a number of minute jets, just touching one another, and consuming each other's smoke, are arranged in the form of an argand burner. These are constructed with 12, 20, or 30 such small holes arranged in a ring. In the Bude light a still more perfect combustion, and still greater economy *(as compared with the quantity of light given out)* is obtained, by placing three or more of such rings of different sizes concentrically within each other, but any larger light or more complicated burner than

the simple 12 hole argand would be seldom required; and for one of these there are usually twenty single circular orifice burners, or bats-wing burners, in which the orifice is a slit, and these would give a far less economical result than what I have taken; for to produce equal quantities of light the consumption of gas in a single orifice burner is more than double (as 5 to 2) what it is in a 20 hole argand burner.

55. When gas is introduced into a town for the first time, the extent to which it will immediately or eventually supersede the pre-existing modes of illumination depends in great measure on the comparative cost of the two methods, but not entirely so; for the cleanliness, simplicity, and facility of management of gas illumination will always give it, for many purposes, an unquestionable advantage over the more troublesome and uncertain modes of illumination, notwithstanding its expense being greater.

56. Supposing a supply of gas at 10*s.* per 1000 cubic feet had been introduced in an English town in which (as in most such towns) tallow candles had been the prevailing mode of illumination hitherto. With gas at this rate the cost of 100 of illumination would be $\frac{1}{2}d.$ per hour, and this would be only one-fifth of the cost of the tallow candles required to produce the same amount of light. Moreover, 10*s.* per 1000 cubic feet is a very high price for gas in England, and of course the cheaper the gas the greater would be the inducement to use it instead of candles or oil.

57. But in Bombay, while 100 of gas illumination would cost $\frac{1}{2}d.$ per hour, 100 of cocoanut oil, fish oil, or coarse castor oil (the illuminating agents in general use at present) would cost only $\frac{1}{4}d.$, $\frac{1}{8}d.$, and $\frac{1}{16}d.$ respectively. It is true that I have taken wholesale prices for these oils, and supposed them burnt in lamps which, though cheap and simple, would develope their illuminating capabilities to the utmost: but I have also adopted a very high co-efficient for the illuminating power of coal gas, and there is a very large margin before the cost of the illumination obtained from these oils could equal that of coal gas at 10*s.* per 1000 cubic feet. Cocoanut oil illumination is as economical as coal gas would be at 5*s.* per 1000 cubic feet, and lighting with fish oil would cost less than coal gas at 2*s.* 6*d.* per 1000 cubic feet.

58. Supposing that the price of oil gas, if not of coal gas illumination, were eventually brought down below that of existing methods of lighting, there would be still some difficulty at first in inducing *landlords* to be at the expense of putting up the gas fittings requisite for its use, for the use of gas could only prove a pecuniary saving to the actual tenants of the premises so accommodated, and these tenants might not think it worth *their* while to pay an increased rent in order to make it worth the landlords' to go to such an expense.

59. I now come to the *5th* and last of the points I proposed to discuss, viz.—"What description of gas, whether coal or oil, would be cheapest for Bombay; and on what scale would it be most prudent to commence the manufacture in the first instance?"

60. I have already said that the question of whether or not the introduction of gas lighting would be found remunerative does not *altogether* depend on its relative cost, as compared with existing modes of lighting; for no other system of lighting can ever be compared to gas illumination for street-lamps and other similar purposes.

61. I fear that the introduction of coal gas would not be found remunerative at Bombay, but I am of opinion that oil gas* would have a much better chance of success.

62. I am led to this conclusion by the fact that coal in Bombay is, and always must be, fully double the price at which such particular coal has been actually shipped in England; whereas oil gas can, I believe, be manufactured in Bombay (owing to the extraordinary cheapness and abundance of the fixed oils of India) for one-half or even one-third of the cost at which oil gas can be made by the Patent Vegetable Oil Gas Company at home.

63. There is no country in the world which produces so great a variety of fixed oils as India, and I believe none in which their price is so low. In Enclosure A I have given an extract from a memorandum by Dr. Hunter (published in the *Madras Athenæum* of the 28th September 1852) on the fixed oils of India, containing a list of upwards of sixty different varieties of oil produced in the interior of that Presidency.

64. For these reasons, I have always been of opinion that in India oil gas held out a fairer prospect of remunerative application than coal gas; but I was not prepared to hear of oil gas competing successfully

* "When oil, fat, rosin, tar, &c. are employed for the production of a light gas, it is not sufficient to introduce these substances into the retorts, and to heat them, as is done with coals. In this case, the greater part of them would distill over in the state of volatile oils, and very little gas be generated—only as much as corresponded to the quantity of fat, &c. in immediate contact with the retort. It becomes therefore necessary to fill the retorts with pieces of brick or cake, and to keep them in ignition, while the oil, &c. is slowly introduced into their interior. The fat instantly assumes the vaporous state, and thus coming into contact upon an extensive surface with ignited bricks, is decomposed into combustible gas. A small portion of carbonaceous matter remains in the retort, while much olefiant gas is formed, possessing a superior illuminating power to common coal gas, and entirely free from sulphureous impregnation. The best oil gas is generated at a dull red, a heat much below what is requisite for the decomposition of coal. A more intense heat would indeed produce a greater volume of gas, but of a poorer quality, because the olefiant gas thereby deposits one-half of its carbon, and is converted into common carburetted hydrogen.

"One pound of oil or fluid fat will yield 15 cubic feet of oil gas.

"The oil employed for affording gas is the crudest and cheapest that can be bought; even the blubber and sediment of whale oil are employed with advantage."—DR. URE.

with that extracted from coal in a country where the former material is so dear, and the latter so cheap, as is the case in *England*. On the appearance of the Patent Vegetable Oil Gas Company's prospectus, I wrote to England for full particulars on the subject, which I received, together with plans and estimates of oil gas works of different sizes, and statements of the actual cost, in oil, coal (for heating the retorts), and labour of the production of each 1000 cubic feet of oil gas in such works.

65. I found, as I had suspected, that it was the extraordinary cheapness of a newly patented oil that had alone enabled oil gas to compete even temporarily* with coal in England. This patent vegetable oil is sold at 1*s*. per gallon, which is stated to be less than a quarter of the cost of any other oil generally used in illumination in England; but I doubt whether, even at this low rate of oil, oil gas can for any length of time compete with coal gas *in England*. With the *Indian* relative prices of coal and oil the case is, however, altogether different.

66. I have appended (see Enclosure B) one of the approximate estimates I obtained from England of the cost of erecting oil gas works and apparatus. This work contains 5 retorts, capable of yielding 15,000 cubic feet of oil gas (equal in illuminating power to 45,000 cubic feet of coal gas) per diem.

67. The cost of producing 105,000 cubic feet (the weekly yield of this work) is therein stated as follows:—

Oil per week, 1,050 gallons, at 1*s*. per gallon, yielding 100 cubic feet of gas per gallon	£52	10	0
Coal per week, at 12*s*. per ton, for heating the 5 retorts....	8	3	4
Labour per week, 5 men, 1 at 32*s*., 1 at 30*s*., and 3 at 21*s*.	6	5	0
Total cost of 105,000 cubic feet of oil gas....	£66	18	4

Or about 12*s*. 9*d*. per 1000 cubic feet of gas; but from the higher illuminating power of *oil* gas this is equivalent to a rate of only 4*s*. 3*d*. per 1000 cubic feet for *coal* gas.

68. But Dr. Ure states that each pound of oil yields 15 cubic feet of gas, and there are more than 9 lbs. of oil to a gallon; each gallon would therefore yield 135 cubic feet, and 1,050 gallons would yield 141,750 cubic feet. This would make the price per 1000 cubic feet about 9*s*. 6*d*., or Rs. 4-12-0, equivalent to a rate of Rs. 1-9-2 per 1000 feet of *coal* gas; but this is without reckoning interest on capital, or depreciation of stock.

The first cost of these works (which are those designed for Eton) is

* There has been within the last few months a great reduction in the price of gas in many English towns; 5*s*. per 1000 cubic feet has now become quite a common rate. At Doncaster it has been reduced to 4*s*. 3*d*., at Wakefield to 3*s*. 9*d*., at Sheffield to 3*s*., and at Whitehaven to 2*s*. 6*d*. It would be more satisfactory if the specific gravity or illuminating power of these several gases could be stated in each case, as the best coal gas would be cheaper at 9*s*. than the worst at 3*s*.

stated in the estimate at £2,856, but this includes street mains, and everything.

69. The illuminating power of the patent vegetable oil gas is stated at three times that of coal gas, and I have received a testimonial from Professor Partington to the same effect. He says that "all photometric experiments give it an illuminating power of three times the common coal gas, and that this result just harmonizes with a long series of experiments he had previously made with vegetable oils."

70. This result does not materially differ from what is stated by Dr. Ure (Dictionary of Arts and Manufactures, page 559) as the result of extended experiments with gas from coal of good and middling quality, and different varieties of oil gas. He says that the *mean* result of these experiments (by which it appeared that the illuminating power of oil gas to coal gas was as 272 to 100) "might be taken to represent the fair average upon the great scale." It was found that *oil* gas of the specific gravity of .965 gave more than three and a half times (as 356 to 100) as much light as coal gas of the specific gravity .429. The mean specific gravity of the different coal gases experimented on was .529, and of the oil gases .960, atmospheric air being taken as unity.

71. Dr. Ure states that a pound of oil or fluid fat affords (at the moderate heat best adapted to the manufacture of oil gas) 15 cubic feet of gas*; this would be about 135 cubic feet for each gallon of oil.

72. I find it stated, as the result of actual experiment in one of the papers of the Patent Vegetable Oil Gas Company, that the amount of gas yielded by each gallon of oil varied from 112½ cubic feet to 150 cubic feet, according to the size of the apparatus, the vapourization of the oil being more complete in the larger retorts. It would have been more satisfactory if the specific gravity of the gas had been given in each case, as by overheating the retort a much larger volume of gas can be always obtained, but lighter, and of a poorer quality; as, when subjected to an excessive heat, the olefiant gas deposits half its carbon, and is converted into common carburetted hydrogen.

73. I have ascertained that the selling price of the cheapest oil used in illumination at Bombay is 6*d*. (4 annas) per gallon, just one-half of the cost of the patent vegetable oil; but I believe that much more economical results might be obtained by using the seed of the *Sesamum orientale*, merely crushed. This seed is extraordinarily rich in oil, and yields it more readily than I believe any other oleaginous seed does. Sesamum oil is the staple oil of the interior. If mere crushing was found insufficient, the gas company should erect oil-mills for itself, the Native presses being so defective as to leave nearly half the oil unextracted.

74. I should think that each pound of broken cocoanut shells would

* For the amount of gas produced by the different varieties of coal, see Enclosure C.

yield 5 or 6 cubic feet of good oil gas, and they might possibly be obtained in sufficient quantity to render it worth while to set apart for their distillation one or more of the numerous retorts which the gas works would contain.

75. I believe, that by making arrangements on a large scale, and by improvements in the presses employed, the price of oil in Bombay might be considerably reduced, and that a still greater economy might be effected by buying sesamum seed wholesale in the interior, and using it merely crushed.

76. As the basis of an estimate of the probable cost of oil gas at Bombay, I will, however, take that of the cheapest description of oil used for illumination at Bombay (refuse castor oil) at what I have ascertained to be its present selling price of 6*d.* per gallon.

77. I will suppose the gas to be manufactured in small gas works, like those specified for in Enclosure B, estimated to cost £2,865, and containing 5 retorts, capable of reducing to gas 1,050 gallons of oil weekly.

78. The weekly expense will be as follows :—

Oil 1,050 gallons, at 4 annas per gallon (each gallon yielding 135 cubic feet gas) ..... Rs.	262	8	0
Coal for heating retorts, 2 tons, at Rs. 10 (half ton to each ton of oil)	20	0	0
Labour, 5 attendants, 1 at Rs. 40, 1 at Rs. 30, and 3 at Rs. 10 per mensem	20	0	0
One week's interest at 10 per cent. per annum on Rs. 30,000, being cost of building, apparatus, mains, &c.....	57	7	2
Rs.	359	15	2

Or say Rs. 360 for 142,000 cubic feet of gas, or about Rs. 2½ per 1000 cubic feet.

79. But oil gas has three times the illuminating power of coal gas; this rate is therefore equivalent to one of under 14 annas per 1000 cubic feet, for *coal* gas.

80. The above estimate for the building and apparatus is certainly excessive, and I believe it might be safely diminished by at least one-third.

81. I think the above allowance I have made for coal would be found sufficient ; the usual allowance for heating the retorts in the manufacture of coal gas is one-fifth of the weight of the coal in the retorts. I have allowed more than twice this, namely one-half the weight of the oil. In the case of coal gas, the distillation may be somewhat more assisted by the partial ignition of the contents of the retorts than when the latter are charged with oil ; but on the other hand, Dr. Ure says that "the best oil gas is generated at a dull red heat, much below what is requisite for the decomposition of coal."

82. As I have before observed, the price of the oil, or of an equivalent of sesamum seed, might be probably rendered very much less than is estimated above ; but on the other hand, though I have allowed for labour, and for interest on capital, I have made no allowance for the expenses of management.

83. I should recommend to any company undertaking the introduction of gas at Bombay, to commence operations by the erection of experimental works on a small scale in the first instance, but built with a view to future extension, as a demand was created ; and I think that such an experiment would be much more likely to succeed as a *branch work* in the hands of a wealthy company, having extensive works in other parts of India, than in those of a distinct local company, which would have to keep up (for Bombay alone) costly agencies and establishments for a concern on too small a scale to bear their expense.

84. There would be no difficulty in constructing these works with a view to future extension; for the principal difference between large and small gas works is simply, that in the former there are a greater *number* of retorts and gasometers than in the latter. But each individual gasometer *may be* the same size in both works, and each retort *must be so*, if it is desired to obtain similarly economical results in each case.

85. The lighting of a few hundred lamps with gas is by no means such an undertaking, nor does it require so large a capital, as appears to be considered necessary at Bombay. In the northern districts of England, there is scarcely a manufactory of moderate size, and requiring light, which does not put up its own little gas work if it be out of reach of the mains of any public company. The cost of such apparatus for a manufactory of moderate size frequently does not exceed £60, and I have known it done for £40. I have mentioned in a former report on the subject that Axminster, a straggling country town in Devonshire, had been lighted by a gas company with a capital of only Rs. 10,000 (£1,000). The experiment whether gas would answer or not at Bombay need not therefore be a very expensive one, and it is certainly well worth trying. I believe that works sufficient for supplying all the gas likely to be required in Bombay for some years to come might be completed, with all incidental expenses *(by a gas company in a large way, and having already a staff in India)*, for Rs. 15,000 or Rs. 20,000.

I have the honour to be, &c.

(Signed) H. CONYBEARE,
Superintendent of Repairs.

Bombay, Superintendent of Repairs' Office, 15th June 1853.

P. S.—The original papers are herewith returned.

ENCLOSURE A.

List of the Fixed Oils of India, extracted from a Memorandum by Dr. HUNTER, *in the Madras Athenæum of the 28th September* 1852.

OILS OF INDIA (FIXED).

Country almond oil	Terminalia catappa.
Castor oil	Ricinus communis.
Cocoanut oil	Cocos nucifera.
Coloquintida seed oil	Cucumis colocynthis.
Cucumber seed oil	Cucumis sativus.
Fish oil, and fish liver oil	.....
Gingelie oil	Sesamum orientale.
Ilpa oil	Bassia longifolia.
Jamaica yellow thistle oil	Argemone Mexicana.
Coarse castor oil	Ricinus communis.
Lamp oil, refuse of do.	Do. do.
Linseed oil	Linum usitatissimum.
Margosa oil, five species	A. Indica azadirachta.
Mustard seed oil	Sinapistoria.
Do. do.	Sinapis Chinensis.
Do. do.	Sinapis glauca.
Do. do.	Sinapis nigra.
Physic nut (a lamp oil)	Jatropha curcas.
Glaucous-leaved physic nut	Jatropha glauca.
Pinnay oil	Calophyllum insphyllum.
Poongum oil	Dalbergia arborea.
Safflower seed oil	Carthamus tinctorius.
Downy mountain ebony	Bauhinia tomentosa.
Thorny trichilia do.	Trichilia spinosa.
Wood oil	.....
Poppy seed oil	Papaver somniferum.
Ground-nut oil	Arachis hypogea.
Cashew-nut oil	Anacardium occidentale.
Marking-nut oil	Semicarpus anacardium.
Cheeronjee berries and seeds	Chirongia sapida, now Buchaniana latifolia.
Saul seed oil	Shoria robusta.
Valuse oil	Guizotia Abyssinica.
Ramtil or valisaloo oil	Guizotia oleifera.
Ponseed or oondee oil	Calophyllum.
Kurrunjee oil	Pongamia glabra.
Country walnut oil	Aleurites triloba.
Hingum or hingota oil	Balanites Ægyptiaca.
Moonela grain oil	Dolichos biflorus.
Vegetable butter	Bassia butyracea.
Epei oil	Bassia latifolia.

Piney oil, or vegetable tallow ..... Veteria Indica.
Kokum oil ..... Garcinia purpurea.
Kiknel oil ..... Salvado a persica.
Vegetable wax..... Gutta podsh.
Coorookoo oil (from Mudura and Tinnivelly). .....
Koodree oil, and Kaisoon oil, from Chota Nagpore ....
Shermandee oil (from Palamcottah) ....
Khatzum oil..... Virnonia anthelmintica.
Cotton seed oil..... Gossypium herbaceum.
Wound oil..... A mixture of two or three pale oils.
Neered dimootoo oil or neeroodoo oil (from Cuddapah)..... .....

The above list of Indian oils had been prepared for publication, and was just going to be sent to press, when a basket containing samples of 12 different oils was received for the Indian Exhibition from E. F. Crozier, Esq., Vizianagram. The following were the oils received :—

Tamil Names.	English and Latin Names.	Remarks.
Nervalum unnay	Croton oil ..... Croton tiglium.	Very clear, colour dark brown.
Khudaghoo unnay.....	Mustard seed oil. ..... Sinapistoria.	Flavour pungent, smell fresh and strong, colour pale.
Eloopie unnay	Ilpa oil ..... Bassia longifolia.	Partially decomposed. This is a solid oil, that will not keep long.
Valisaloo unnay.....	Ramtil oil ..... Guizotia oleifera.	Colour clear, straw yellow, little smell.
Vay pum unnay No. 1.....	Margosa oil No. 1. ..... Azadirachta Indica.	Colour of pale sherry, smell strong, disagreeable.
Vay pum unnay No. 2.....	Hill margosa oil..... Melia azaderach.	Colour of amber, smell very strong, like bad meat.
Pyratic cottay unnay.....	Cotton seed oil ..... Gossypium herbaceum.	Colour of claret. This is a drying oil.
Cangoo unnay No. 1. .... Or Kurrunja katel.	Cangoo oil No. 1..... Poongamia glabra.	Colour of pale sherry, little smell.
Cangoo unnay No. 2..... Or Poongum unnay.	Poongum oil ..... Dalbergia arborea.	Colour of dark sherry, smell strong.
Brumnadundoo..... Or Bulruckasee.	Jamaica yellow thistle seed oil. Argemone Mexicana.	Colour pale yellow, like linseed oil, very little smell.
Nal unnay.....	Gingelie oil..... Sesamum orientale.	Quality very fine, smell faint, like fresh butter.
	Wound oil.....	A mixture of some clear oils.

The demand for the oils of India is steadily on the increase, and it is desirable that every means should be used to give publicity to the subject, as there are several manufactures in which the solid fatty oils

of India might be advantageously substituted for tallow, wax, or spermaceti. Some of the fine oils of this Presidency might also be brought more extensively into use if more were known about their quality, colour, smell, and price.

(Signed) ALEX. HUNTER.

—*Madras Athenæum, September 28th*, 1852.]

ROYAL ASIATIC SOCIETY LIBRARY OF THE BOMBAY BRANCH OF THE

ENCLOSURE B.

Approximate Estimate for erecting the Gas Works at Eton.

Brick retort house to hold seven retorts				£ 250	0 0
No. 1 gas holder and tank complete, 40 feet diameter, and 12 feet deep				1,100	0 0
No. 2 gas holder and tank complete, 18 feet diameter, and 10 feet deep				400	0 0
5 Retorts, with condensers and washers, complete				800	0 0
Mains, confined to the limits of the gas works ..	£ 25	0	0		
Valves, do. do. do.	15	0	0		
Syphons, do. do. do.	16	0	0		
				56	0 0
Approximate quantity of street mains; say half a mile of mains of various sizes, viz :—					
300 yards of 5-inch main 300 do. of 4-inch do. 280 do. of 3-inch do. }				250	0 0
				£ 2,856	0 0

[MEMO.—The above apparatuses will make 15,000 cubic feet in 24 hours, or 105,000 cubic feet per week.]

Cost of fuel for each retort per 24 hours may average 4*s.* 8*d.*, or per week				£ 8	3 0
5 men will be required.... { 1 at 32*s.*	£ 1	12	0		
1 at 30*s.*	1	10	0		
3 at 21*s.*	3	3	0		
				6	5 0
Oil produces 100 feet per gallon per week, 1,050 gallons, at 1*s.* ..				52	19 0
Total.. ..				£ 66	18 4

Cost per 1000 cubic feet 12*s.* 9*d.*

The cost of each light per burner per hour is 1½ farthing.

A comparison of this light with that of wax candles of the standard consuming 120 grains per hour, and cost 3*s*. 6*d*. per lb., each gas light being equal in illuminating power to 10 candles, will result as follows, viz :—1 candle consuming 120 grains, 10 candles consume 1,200 grains per hour ; and as 1 lb. or 7,000 grains of wax candles cost 42*d*. the cost of 1,200 will be equal to 7·4*d*. to produce the same amount of light.

Thus the cost of wax candle light is to that of this gas light as 19$\frac{1}{3}$ are to 1.

ENCLOSURE C.

Copy of a Paper submitted to a Committee of the House of Commons in the Session of 1837, *being a Synopsis of the Proceedings of the under-mentioned Principal Gas Light Establishments of England; and procured by Actual Survey and Experiments between the Years* 1834 *and* 1837. *By* Joseph Hedly, *Esq.*

Years of the Place where Gas Works are situated.	Price of the per Metre, and Discounts allowed.	Price of Coal, and Description delivered per Ton.	Average Quantity of the made per Ton of Coal.	Coke made from a Ton of Coal.	Selling Price of Coke.	Material used to heat Retorts.	Quantity used per Ton of Coal.	No. of Perfo- rated or Street Lamps supplied.	Description, Size, or Sort.	Price used per Annum for diths.	Who lights, cleans, puts out, and repairs.	No. of Hours, or Time burnt in the Year.	Gas consumed in each Lamp per Hour.	Gas supplied for Coke Ovens.	Annual Quantity, not including that supplying Coke Ovens.	Per-centage of Loss of Gas made.	Greatest Quantity of Gas delivered in One Night.	Duration of Charge.	Method of Perfora- tion.	Number of Gas Holders.	Specific Gravity of the Gas.	Thickness of Cast-Iron Holder.	Gas Stored in a single Lift. Feet Cubic Cubic Feet.	Pressure in Tenths of an Inch, with a Patent Pitot Tube.	Gas Flame reduced to Candle-power per Hour, by Patent Photometer.	Gas Flame reduced to Candle-power per Hour, by Standard Candles.
			Cu. ft.							£. s. d.			*c. f.*									*Inch.*	*Cent.*	*Cu. ft.*	*Cu. ft.*	*Cu.*
Birmingham Gas Company.	10s. per 1000 cub. feet. Discounts. 25l. to 50l. 5 per cent. 50l. to 75l. 7½ per cent. 75l. to 100l. 10 per cent. 100l. & upwards 12½ per cent.	Lump coal from West Bromwich pits three miles north of Birmingham, 1837, 11s. 10d.	6,300	20 bushels.	2s. 1d. per quarter delivered, or about 8d. per bushel.	Slack.	About 1 cwt. of Slack, or 6s. per ton, 35 per cent.	420	Ratswings.	420 0 0	Company, and pro- vides posts, ser- vants, &c.	3200 nights, or 8,000 hours, 9 months, omitting 3 nights for moons.	5 ft. per hour.	20 to 40	18	6	Receives nett about 6d. 6d. per 1000 cubic feet.	Cubic Feet. 40 millions in the year.	5 hours.	Dry Line.	4, and 2 in the town, and large new gas station.	0.435	7/8	1,800	2·05	8	25
Birmingham and Staf- fordshire.	10s. per 1000 cub. feet. Discounts as above.	Penn Wood Bromwich pits, 1837, 9s. 3d.	6,500	14 bush., but large quan- tities over Birming- ham.	1s. 10d. per sack of 2 bushels.	Slack and Tar.	1 cwt. of Slack, or 6s., 25 per cent.	1,500	Ratswings.	Average 1 18 0	Ditto.	3264 nights, or 8,160 hours.	Do.	1	2½	19	6	Receives nett about 5d. 6d. per 1000 cubic feet.	15 millions in the year.	Ditto.	Ditto.	4, and 6 in the town, 7 miles off.	0.435	7/8	1,800	2·05	8	25
Manches- ter.	10s. per 1000 cub. feet. Discounts as above.	Common, 8s. average 1834.	6,720	12 cwt.	10s. per ton.	Coke.	7c average kept.	320	Ditto.	3 10 0	Company.	9 months, omitting 3 nights for moons.	6 ft. per hour.	3	0	12	0	Could not say.	80,000. Total for year about 13 mil- lions.	9 hours.	Ditto.	4 gas holders.	Not taken.	7/8	800	Not taken.	8	25
Southport.	10s. per 1000 cub. feet. Discounts same as Man- chester. Meters from Southport card.	Coal 10s. del. Central Dis.&c., about half and half coal, Arley- aga 12s. 1834.	7,800	7 cwt.	9s. 6d. per ton.	Coal, Coke, and Tar.	Ditto.	320	Ditto.	3 10 0 2 0 0 1837.	Commissrs. provide keeps and posts; Company's ser- vice light, repair, clean, and extin- guish.	3 months, 4 nights omitted for moons, 237 nights, 2,840 hours.	Do.	2	0	12	0	Ditto.	22,000. Total for year about 12 mil- lions.	Ditto.	Ditto.	1 gas holder.	0.36	3/4	9,440	0·5	0·5	2½
Manchester.	10s. per 1000 cub. ft. 1834. to end of Dec. 1837. Discounts. 2nd. 1000. 5 per cent. 3rd. under 1500. 7½ per cent. 4th. under 2000. 10 per cent. 5th. and under 2500. 12½ per cent. 6th. 2500. 15 per cent. 7th. and upwards 17½ per cent.	12s. 6d. average. Oldham ; Wigan ; Wingates ; Worsley ; Kersley ; Mixed, 1834.	9,500	14 cwt.	Ditto.	Coke.	4¾ cwt.	2,370	Single jets and 5d. flames ; fixed at half and half.	1 2 0 2 0 0	Commissioners of Police.	3,200 hours.	1 foot. 2 feet per hour.	0 0 0 2	....	About 15 to 17½ per cent.; receive about 5s. 6d. per 1000 cubic feet, public and private. Nearly all by meter.	320,000. Total for year 700 millions.	4 hours.	Wet lime.	10 gas holders and 2 in the town.	0.364	3/4	2,250	0·25	0·75	2½
Liverpool Old Company, 1834.*	10s. per 1000 cub. feet. Discounts. 25l. to under 50l. 2½ per cent. 50l. to 100l. 5 per cent. 100l. & upwards 7½ per cent.	7s. 5d. per ton of 112 lbs. per cwt. Cleveland, or Wigan Cannel.	9,200	11½ cwt.	8s. 4d. per ton of 112 lbs. per cwt.	Slack. 7s. 5d. per ton.	6¾ cwt.	1,700	Ratswings. 1 jet. 2 ,, 3 ,, 4 ,,	4 10 0 3 5 0 3 15 0 3 0 0 3 12 11	Company light, clean, put out, and repair.	3,600 hours.	5 ft. per hour.	4	4	19	0	Could not learn in the absence of the Manager.	800,000. Total for year 72 millions.	6 hours. large re- torts, heating 6 cwt. each.	Wet and dry line, principal- ly dry.	3 gas holders in all, 4 in the town, 1,000 yds. of the works.	0.402	7/8	1,777	1·1	0·75	2½
Liverpool New Gas and Coke Co. 1835.	10s. per 1000 cub. feet. Discounts same as Liver- pool Old Company.	10s. All Cannel, Wigan.	9,500	12 cwt.	7s. 6d. per ton.	Coke and Slack.	5¼ cwt. Dw.	Daily 4	Argands.	4 0 0	Commissioners.	3,600 hours.	5½ ft. per hour.	5	0	....	Nearly all by meter.	Not sufficiently long at work.	4 hours.	Wet line.	2 large gas holders.	0.366	5/8	2,300	0·9	0·45	2
Salford, 1834.	8s. per 1000 cub. feet in large quantities. Discounts. 20l. to 30l. 5 per cent. 30l. to 40l. 7½ per cent. 40l. to 50l. 10 per cent. 50l. to 60l. 12½ per cent. 60l. to 100l. 15 per cent. 100l. & upwards 20 per cent. Small consumers, less than 1000 cubic feet used 1 per cent. off from 20l. to 40l.	8s. 6d. per ton ; some used ; average Slacks. 5s. 6d.; Low Moss 6s. 10d.; Cumberland Slacks 5s.	8,000	12 cwt.	10s. per ton.	Coke.	4½ cwt.	320	Ratswings.	3 12 0	Company light, re- pair, &c.	3 months, omitting 7 nights, 2,600 hours, to 4 o'clock in the morning.	5 ft. per hour.	3	1	12	0	Receive 8s. per 1000 cubic feet, less 2½ per cent.	42,500, 8,500,000.	4 hours.	Dry line.	4 gas holders.	0.39	7/8	1,645	1·2	0·5	2
Leeds, 1834.	8s. per 1000 cub. feet. Discounts. 25l. per cent. net 3 mos. 5 per cent. 3 and 6 months 7½ per cent. 6 and 9 months 10 per cent. 9 and 12 months 12½ per cent.	8s. per ton average ; two-thirds common, To. 1 common third Cannel, 16s.	6,500	12 cwt.	7s. 6d. per ton.	Ditto.	5½ cwt.	317	Ditto.	3 12 0	Commissioners, except extinguish- ing, for which Company has 2d. per lamp.	3,250 hours.	4 ft. per hour.	3	2	3	11	Receive for public and private 5s. 6d. per 1000 cubic feet. Public 5s. ; private 7s. Misers pay 1s. 6d. for private rental.	170,000. Total for year 21 millions.	3 hours.	Ditto.	3 gas holders.	0.39	6/7	2,250	0·6	0·5	2½
Hull, 1834.	8s. per 1000 cub. feet. Discounts same as Leeds.	7s. 5d. per ton average, 2 cannel, 1 two-thirds Cannel, at 16s.; 10, two-thirds dirty ditto, 7s.; one-fifth Silkstone, 10s.	6,600	13 cwt. of re- leable Coke	10s. per ton.	Ditto.	5½ cwt.	600	Ditto.	3 10 0	Company provide keeps, clean, re- pair, put out, &c.	3,200 hours.	Ditto.	3	2½	18	0	Receive for public and private lights 5s. per 1000 cubic feet. Public 5s. 6d.; private 5s. 3d. Few meters used.	220,000, 40 millions.	Ditto.	Ditto.	4 gas holders, and 4 manu- creating.	0.426	7/8	1,850	1·06	0·75	2
Leamington, 1834.	10s. per 1000 cub. feet. Discounts as above. Consumers not entering 10l. per annum 5 per cent. 10l. and under 20l. 7½ per cent. 20l. and under 30l. 10 per cent. 30l. and under 40l. 12½ per cent. 40l. and under 50l. 15 per cent. 50l. & upwards 20 per cent.	12s. 6d. average. Derbyshire and Coal.	7,200	4 cwt.	10s. 6d., to 12s. 6d. per qr.	Coke Tar, &c.	About one-third Coke.	414	Ditto.	3 18 0	Company light, pur- cost, and clean.	From August 14th to September 1st, omitting 3 nights for moons, 2,600 hours.	6 ft. per hour.	3	4½	7	0	Not sufficiently long at 7s. 6d.	Total for year 18 millions.	Ditto.	Ditto.	2 gas holders, and 1 exam- ining.	0.39	7/8	1,800	....	0·5	2½
Dudley, 1834.	10s. per 1000 cub. feet. Discounts. 5 to 10 per cent.	Some Coal used as at Leicester.	7,200	Ditto.	Ditto.	Coke.	Ditto.	320	Ditto.	3 2 0 2 7 6	Commissioners light- pur cost, &c.	3,173 hours, from August to May.	Ditto.	4 0 nearly	....	Less about 17½ per cent.	Ditto.	Ditto.	Wet line.	4 gas holders.	0.40	7/8	1,450	1·0	0·25	..
Nottingham, 1834.	8s. per 1000 cub. feet. Discounts as above.	Ditto.	7,200	Ditto.	Ditto.	Ditto.	Ditto.	320	Ditto.	3 2 0	Commissioners light- clean, repair, &c.	All the year, 4,827 hours.	Ditto.	3 0 nearly	....	Could not learn.	Ditto.	Ditto.	Ditto.	.....	0.34	3/4	1,284	1·0	1·375	2
London, 1834.	10s. per 1000 cub. feet. No Discounts.	17s. average. Newcastle.	8,200	30 bush.	12s. per chal- drun.	Ditto.	13 bush.	30,000	Ditto.	4 0 0	Company light, clean, put out, but not repair.	4,327 hours, all the year.	4 ft. per hour.	4	0	12	0	Receive for public and private lights 7s.; public 6s., private 6s. Few meters used.	Total for year 1000 millions; largest nights 4,000,000.	Ditto.	Ditto.	330 gas hold- ers.	0.42	7/8	1,600	1·25	0·4	2½
Bath, 1837.	Ditto.	Ditto.	8,500	Ditto.	Ditto.	Ditto.	Ditto.	30,000	Ditto.	4 0 0	Ditto.	Ditto.	Ditto.	4	0	12	0	Total for year 1,500 millions; large 4 nights 7,000,000.	Ditto.	Ditto.	170 gas hold- ers.	0.42	7/8	1,600	1·25	0·4	2½

* In 1835 this Company changed to the use of Cannel Coal similar to the Liverpool New Gas and Coke Company, producing nearly similar results, which see.

(V 1B3S)

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